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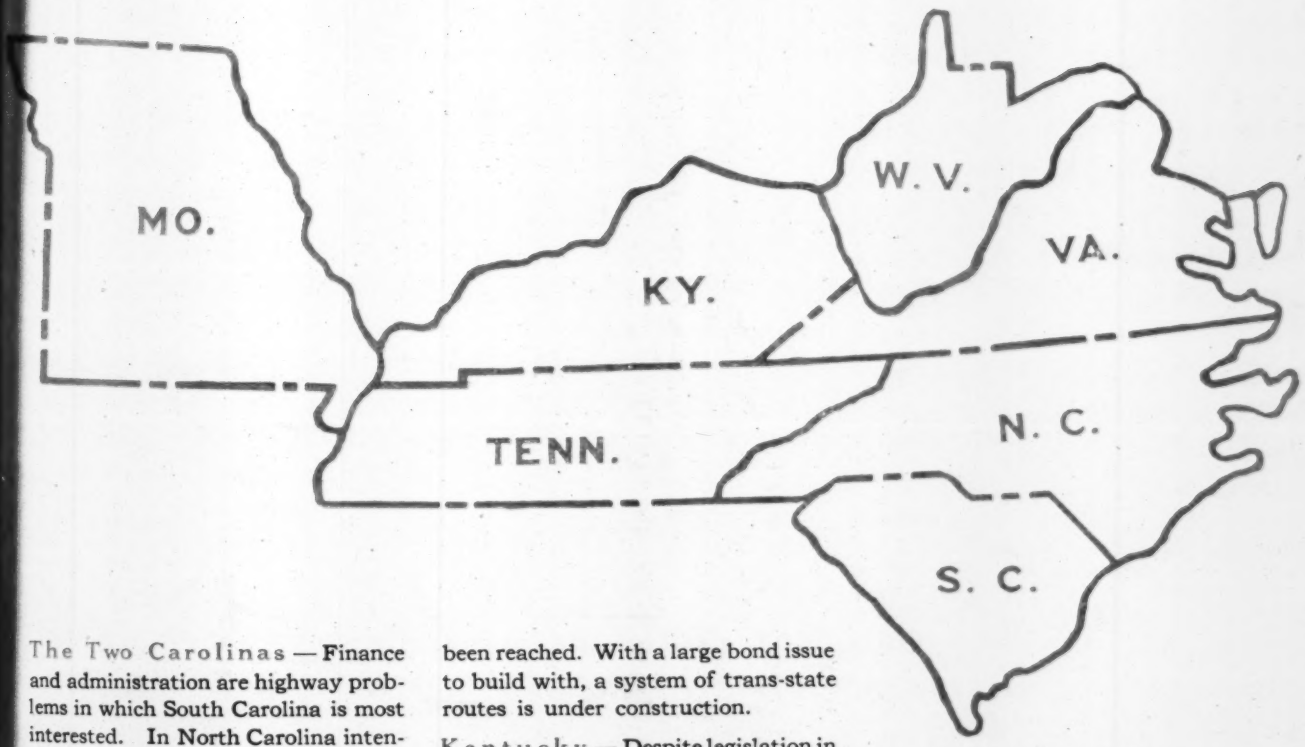
Road Expenditures Contemplated by Seven Southern States Approach $1,000,000,000

An editorial discussion on what they are doing in highway work begins in this issue



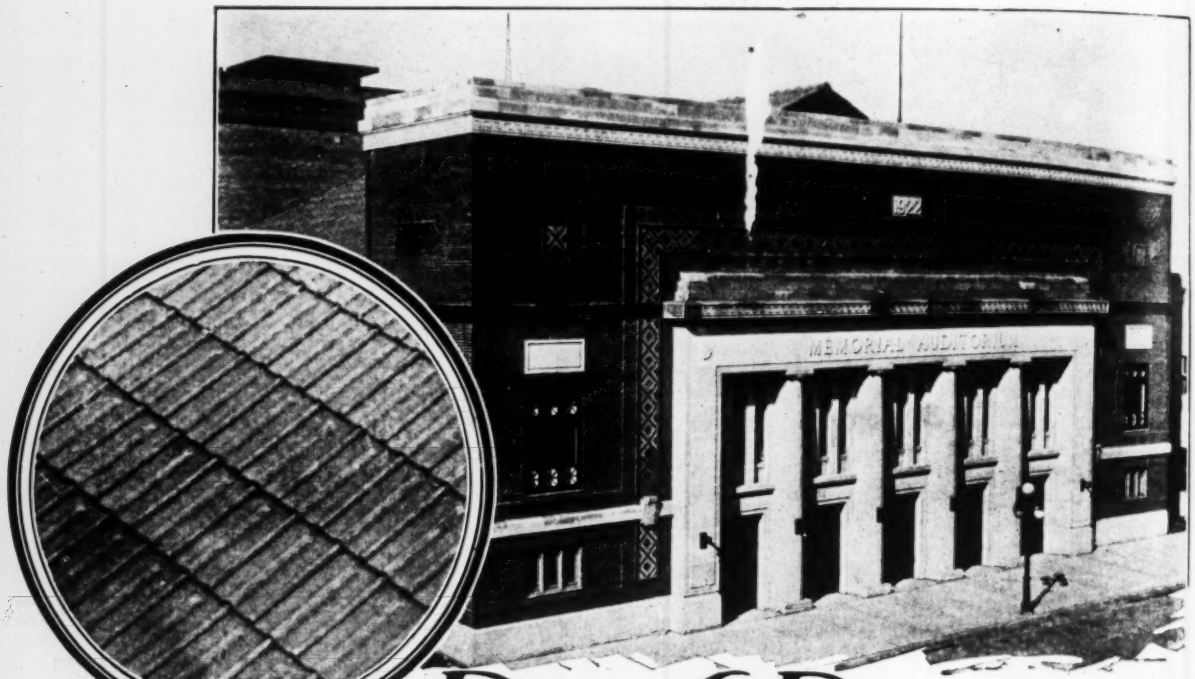
The Two Carolinas — Finance and administration are highway problems in which South Carolina is most interested. In North Carolina intensive development is already under way. Characteristics of its progress are efficient administration, progressive construction and full-system maintenance.

The Two Virginias — Highway development in Virginia awaits the result of a bitter contest over methods of financing: but in West Virginia an advanced stage of construction has been reached. With a large bond issue to build with, a system of trans-state routes is under construction.

Kentucky — Despite legislation in 1920 establishing strong centralized state direction of road improvement, Kentucky has been left with a legacy of debt accruing from past county control. Comprehensive highway financing is the pressing need.

Tennessee — Like Kentucky, Tennessee lacks money for system highway development. Roads are being built, but they are disconnected. County co-operation is the theory of road development in this state.

Missouri — There is under way in Missouri one of the largest road building programs of any state in the Union. Progressive construction and full-system maintenance are combined with education to make the highway plan a popular success.



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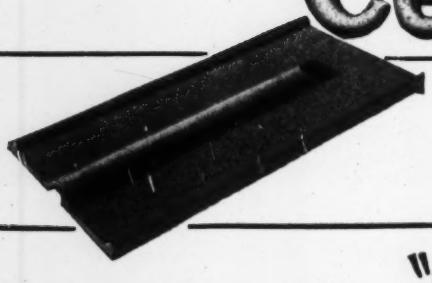

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Toward Society Co-operation

WHILE President Loweth of the American Society of Civil Engineers was expressing only his own views on a matter of society policy when he discussed co-operation at the Chicago meeting, it may well be assumed that his views are the result of a careful analysis of the trend of membership opinion, which should govern the intentions of the committee of the society now studying this most important question. As a prospectus with obvious limitations his remarks contain a few excellent basic principles. The most important of these is the statement that the chief function in co-operation should be to bring about concerted action of various organizations rather than to attempt to speak for them. If the committee of the American Society of Civil Engineers can propose a scheme acceptable to the other engineering societies by which this end will be achieved, society co-operation in the best sense will soon become a fact. It is absurd to think that the whole great and diversified engineering profession can speak as one voice. The thing which needs to be done is so to co-ordinate the thinking of the various important societies that they can readily get together their opinions, whether similar or diversified, and unless those opinions are too diametrically opposed can achieve some degree of compromise which, expressed through the separate voices of the different societies, will come to the public ear with the additional force of diversification and distribution. Details of organization of such a system are very great, and will doubtless be subject to considerable criticism even after they have been worked out by the committee itself, but the principle laid down by the president might well govern the committee in the study of its problems.

Aiding Water-Waste Prevention

CHICAGO water-waste continues, but no longer without official cognizance or attention. Both mayor and commissioner of public works are using in public speeches words, phrases and arguments framed by engineers, mostly from a brief submitted to them by the Western Society of Engineers. In making up the brief the public affairs committee of that organization had in mind just such use and in consequence the conclusions of the brief were short, illustrative, comparative and calculated to appeal as seriously as possible to the councilmanic constituency. Laying stress on savings was not considered as having anywhere near the pulling value as the startling information that 75 per cent of the city had a decidedly inadequate service in the summer when it is most needed. In the last analysis the citizen wants service—he does not get it in Chicago and never will so long as the pumps must deliver into a sieve-like system. The newspapers have given columns of space to the waste-prevention campaign, nearly every item bearing the earmarks of the society's report. If Chicago ever does stop wasting water the members of the society's public affairs committee may well feel repaid for their noon-hour conferences, where were discussed the pros and cons of political appeals to a strictly engineering administrative policy.

Crude Figures Misleading

PRESIDENT HARDING'S note of alarm over our mounting state and municipal expenses and debts, sounded in a recent speech at Salt Lake City, was unfortunately based on bare totals and percentages. Had the President made no allowance for any factor entering into the increase except the decreased purchasing power of the dollar, he might have been astounded at the result and been forced to commend instead of blame our cities if not our states for their moderation during the seven trying years since 1914. If in addition he had taken into account population growth since 1914, higher capital costs, and increased operating charges due to run-down plants through deferred repair and renewals, and other factors the whole tenor of this part of his address would have needed marked change. Crude bulk statistics, used without qualification, are always likely to mislead, but seldom are they so gravely misleading as in the discussion of state and city expenses and debts sent reverberating over the country by the President.

California Starts Subgrade Survey

IN THE light of the Pittsburg test-road experience with adobe subgrade construction, it is noteworthy that the California road department has begun a field survey of road foundations. Until now all the systematized records available on foundation materials and structure have come from experimental roads and while they are important there is always present the reflection that in some degree laboratory conditions instead of the comparatively unregulated methods of actual field construction are represented in the results. From all reports, however, the California survey will have particular reference to the character of the foundation soil. It is to be hoped that there will go with this soil sampling the best determination possible in each case of the method of preparing the subgrade and of drainage conditions. A soil survey, useful as it will be, is certain to be only a fraction as useful as it would be if co-ordinated with information on construction methods and drainage. The stable subgrade secured with adobe soil on the Pittsburg test road was the result of the method of construction and not due, it would appear, to any unusual character of the material. A soil analyses alone would have shown presumably nothing of the real reason for the success of the foundation. In any event we need to know all that is possible of subgrade structure and drainage in relation to road durability and the soil survey furnishes an opportunity conveniently to secure such knowledge.

Express-Train Service

A STRIKING feature of the new Chicago rapid transit plan summarized last week on p. 104 is the absence of any general provision for express-train service such as is now operated on most of New York City subways and elevated lines. It is obvious from the fact that the proposed subways and elevated lines are almost entirely double-track structures that an express service is not contemplated. It may be that the committee made a study of the needs of the city in regard to an express service on some or all of the lines and that the idea was abandoned as not justifying the additional expenditure required to three-track or four-track the new line. Or it may be that with the proposed unification of the surface lines with the elevated and sub-surface lines the committee considers that stations can be put at express intervals. If so, the practical workings of such an arrangement will be of great interest to all cities now struggling to provide adequate rapid-transit facilities. Its possibilities for providing immediate relief of the transit situation in New York are enormous. The present four-track subways could, during rush hours, be converted into subways with two lines of express service in the direction of maximum traffic. In this case the people would have to be diverted to the surface lines for the last few blocks of their journey. But if this is not contemplated, if the new plan calls for stations at the usual interval of about one-third of a mile, it does not seem that it will be adequate for a city of the extent of Chicago. Relative distances are not so unlike in New York and Chicago that New York's experience in the use of express trains cannot be taken as a criterion. The benefits which New York derives in an increasing degree as traffic increases amply justify the expense of express service; similar benefits are to be expected in Chicago's rapid transit.

Bridge Design and Good Taste

AN ARTICLE which appeared last week in a magazine of opinion denounces the design for the Hudson River suspension bridge at Bear Mountain as ugly, and proceeds to deplore the defacing of a beautiful landscape by such a bridge. One can hardly take exception to this as a setting forth of the author's likes and dislikes, assuming that they are worthy of being brought to general attention. There is no disputing over tastes. But the author is on less sure ground when, after admitting that he is not competent to say what kind of bridge should be built, he continues, "I think I have enough esthetic sense to say that the design is, on the face of it, hopelessly incompetent." Here we have not a statement of likes or dislikes but an arbitrary dictum. It is extravagant enough to be its own answer.

A word, however, on the question of ugly suspension bridges. Beauty is an elusive matter to discuss, but the case in hand is simplified in respect to the important element of esthetic precedent. Not a great number of suspension bridges has been built in the entire world, so far, and there is no agreement of precedent on proportions, or trussing, or other phases of the design. In this virgin field the one certain fact is that the best suspension bridge is the one that is most efficient *as a suspension bridge*, and which gives expression to its functioning most truly and directly. And truth, we have it on the best authority, is beauty. Whether the line of the cables shall remain above the truss or not, whether the truss must have parallel chords—or, for that matter, whether the towers are to be stone or steel or vertical or inclined toward stream or bank—may be judged by the criterion of how the efficiency of the structure is made greatest, that is by how truly it performs its desired function. We are not compelled to defer to dogmas of taste established by the building of certain bridges some centuries ago, which, famous through hundreds of years, now set the norm of good taste. The suspension-bridge engineer, happily, need not even in highland scenery vindicate his skill in efficient design by building baronial castles in imitation of venerable ruins of a former efficient adaptation to purpose.

So for many years, as at present, the planning of suspension bridges will be a free art, in which the keen analysis of truly efficient construction will tell what is true beauty of form. The art will not have to go through such struggles against fancied doctrines as involved the builder of truss bridges when he undertook to show that straight lines might serve the world better than the beauty of the arch. Nor will it, we hope, become subordinate to copy book esthetics as did those early builders of plate girders who felt obliged to mask the "ugliness" of their web rivets by appliquéd rosettes.

And finally, the oft-repeated cant about defacing Nature's beauty with ugly works of man is worth a few moments' reflection. This matter is one of sharply dissonant opinions. An extreme note is sounded in the article above quoted, when the author asks that a bridge shall "contribute to the beauty of the Hudson" rather than mar it. Many among those who feel the beauty of a landscape will resent the suggestion that a bridge—however beautiful in itself, however ornamented—can contribute to the beauty of the Hudson. Others again, and we think their number will also prove to be many, will deny that a bridge makes the beauty of such a landscape either greater or less; in their view, the landscape remains as beautiful as before, except where concealed by the bridge. The numerous phases of the question are even more in dispute than the question of the inherent beauty of the bridge. Yet it is brought to the front whenever it is necessary to decide (for example) between stone and steel, or girder and arch. On one occasion it will be claimed that steel construction is always ugly and only stone will do; or again, that a hilly landscape with its curving lines demands curved lines also in a bridge. Thus arguments without base or reference point recur and recur, and while dispute concerns itself with harmony the virtues of contrast rarely receive a thought.

At all times, we believe, it will remain an involved and delicate question, quite too delicate to serve as foundation for such rash and bald conclusions as those expressed in the article quoted. When minimum disturbance of the pre-existing landscape with human construction is most satisfying it will be obviously desirable to make a bridge unobtrusive; when it is best that a structure should not insistently claim the center of the picture, a quiet and consistent outline will commend itself. A few such considerations may be set down; but in its larger aspect the question of harmony with Nature will always remain one of good taste—a quality of fully as much value to the bridge engineer as to the architect.

Some Problems in Rail Consolidation

IN THE proposed consolidation of practically all the railways of the United States to form a limited number of large groups or systems, as provided by the Transportation Act of 1920, the railways face a problem which seems likely to rank only second to the valuation problem in point of difficulties and complications involved. This problem is of interest to the engineer from its probable influence upon railway engineering in particular as well as upon railway affairs in general. His main work will come after the final establishment of the several groups. Then it will be his duty to revise and improve physical conditions and operating facilities on various weaker links in new traffic routes which will need to be developed. Nevertheless there are some engineering and traffic complications involved in consolidation which will bear emphasis.

Under the provision for continuing competition in the transportation act, consolidation must provide systems of interlocking and overlapping arrangement, and not merely separate systems serving different geographical districts. The law is permissive merely, although compulsory powers were included in the original draft, but because it was evident that private initiative alone could never reach the stage of devising or agreeing upon a national grouping of the railways, provision was made for suggestive arrangement of systems by the Interstate Commerce Commission.

A tentative series of nineteen groups has been drawn up by the commission as a basis, their lengths ranging from 3,000 to 22,000 miles, and public hearings have been held for the presentation of the views and objections of railway executives, state commissions, commercial organizations and other varied interests. It is unfortunate that the majority of the arguments have indicated destructive criticism, narrow-gage ideas, lack of foresight, and vision restricted by local or selfish factors. The broad question of consolidation in regard to public welfare and national commerce has been visualized only by a few of the many speakers. Few seem to realize that consolidation is not a paper theory but is a very practical and pressing probability.

According to a report prepared by a committee of the National Industrial Conference Board, the railway executives in general favor the principle of consolidation and regard its application as inevitable. Naturally a railroad strong in financial position, earning power, traffic capacity or physical condition might object to having weaker or less favorable roads annexed to it in a consolidated system. But on the other hand a strong company left alone and surrounded by larger competitors might lose much of the financial and strategic factors of its present individual strength. One special difficulty, perhaps, will be in securing harmony when one present road or system is to be partitioned between two of the new groups to insure effective routes and groups.

The final adoption of a series of groups by the Interstate Commerce Commission does not guarantee financial success or operating efficiency for the several groups. Possibly it is not fully realized what great responsibility will thus rest eventually on the shoulders of the commission. It is true that some of the difficulties may prove less serious than expected and may be smoothed away, but new and unexpected difficulties are likely to arise. It is true also that the law provides for changes subject to the final grouping. Such changes could be made only slowly and after much deliberation, so that they could hardly be relied upon as a means of avoiding or rectifying serious financial or operating difficulties resulting from errors in grouping.

One feature of consolidation in which the engineer is particularly interested is that of the relative physical condition of lines put together to form a group or operating system. With the aid of a good railway map it is not difficult to select logical groups and logical routes within a group. But the map does not show physical conditions. Take certain proposals for linking up through routes between South Atlantic ports and the Great Lakes. In one of these it was proposed to combine two competing lines which are nearly parallel for part of their length, so as to form a duplicate line of heavy traffic or alternative lines in case of accidental blocking of either one line. The lines are physically connected at certain points and the arrangement appears favorable. But it developed that these connections are not well adapted for through service and that considerable new construction would be required at heavy cost to make such a plan workable.

In another case, an east-and-west trunk line was to be given a northward connection to a lake port. But the trunk line objected that this link had such excessive curvature and grades, combined with light construction, that it could not handle the intended traffic except after costly and extensive improvements. Furthermore, a very similar but not directly parallel lake connection of another trunk line is well adapted for the economic handling of heavy traffic. As a result the latter group would have a distinct advantage in handling lake traffic. This situation at once suggests the question of how the less favorable lines are to be handled and how some kind of balance is to be contrived.

New traffic routes are likely to become logical and available in the consolidated systems, but may be composed in part of lines which at present are of a secondary character. It is probable, therefore, that a considerable amount of improvement work will be required in each group to perfect new routes, and to improve operating conditions. Extensive changes in terminals, yards and other facilities may also be foreseen.

While the main problem is the grouping of the railroads throughout the body of the country, a secondary problem is presented by the semi-isolated sections of the country. Thus in regard to the New England railways there is a question whether they should be consolidated to form a single group with gateway connections to trunk lines of adjacent systems, or whether they should be divided among such trunk lines in order to form New England extensions of the latter. Under the law the grouping is required to retain competition as far as practicable. But in the first case the competition would be that of trunk lines for the traffic of the New England group, while in the second case it would be between the different lines in New England.

In conclusion it may be said that the movement is going forward steadily and that actual consolidation may be regarded as imminent. If the objectors would see the handwriting on the wall they might realize that their interests lie in co-operation rather than in controversy. To the engineer and the railroad operating officer there may be visions of a much greater, more effective and more economic railway system than that which is now composed of numerous separate individual railways, large and small.

Highway Progress and Problems in the Mid-South

South Carolina	North Carolina
Virginia	West Virginia
Kentucky	Tennessee
Missouri	

Seven Southern States Contemplate Road Expenditures Approaching a Billion Dollars — Automobile License Fees and Gasoline Taxes Will Provide the Money—Editorial Review Based on Studies in the Field

In a few years the banner of quantity production of improved roads will pass to the states lying immediately south of the Mason and Dixon Line and including Missouri. To meet this change there must be a large development of all the agencies of highway building. Engineering organizations must be enlarged, materials production increased, equipment service extended and contractors trained in modern road building. All this necessitates a long look ahead and constructive planning by engineers, contractors, manufacturers and materials producers. It is to help in this planning that the following studies of highway progress and problems in the South were undertaken.

The broad outlook has been assumed in these studies. Technique of design and construction is not discussed; it shows no notable variations from good practice in the older road building states of the North. Instead, the attempt is made to visualize the broad fundamental problems of finance, administration, popular education and traffic development. To get these wide aspects a month of intensive work in the field and some 3,000 miles of travel have been required. The interviews and conferences have not been with road department officials alone but have included bankers, leading merchants, commercial organizations, highway associations and prominent engineers and contractors. Even the viewpoint of the man in the hotel lobby and the smoking car has not been despised. Naturally all there is to learn has not been grasped and only the high points of what was learned are indicated. They, however, seem to present a chart of highway development which can be examined to advantage by all who look to road building as a continuing business for their employment and profit.

Group Problems Summarized

THE WAVE of large mileages in highway construction is moving southward. In the zone of states embracing the Carolinas, the two Virginias, Tennessee, Kentucky, Missouri and Kansas, only Kansas registers an ebb in the flood. Seven states are planning or proceeding with construction programs surpassing in the amount of money involved all but those of a few states. In the next five years the great records of mileages under construction will be made not by Pennsylvania, Illinois, Wisconsin, Michigan and other northern states but by those mid-southern states which have hitherto counted small in the active production of modern roads. Already in North Carolina and Missouri more miles of highway are under contract than in any of the states previously known as leaders in new construction.

Perhaps the best measure of this sweep of highway development toward the South is the expenditure which is being contemplated. In three states, highway bonds have been authorized in the following amounts: North Carolina $65,000,000, West Virginia $50,000,000 and Missouri $60,000,000. In four states legislation has been inaugurated for highway bond issues in amounts as follows: South Carolina $60,000,000, Virginia $50,000,000, Kentucky $50,000,000 and Tennessee $75,000,000. The aggregate is the enormous amount of $410,000,000. For 1923-24 the federal-aid allotment to these seven states is something over $9,000,000. Assuming a construction period of ten years, continuing federal aid, normal county and township road building and the amount of bonds named, the expenditure for roads will amount to something over $600,000,000, without considering the growth of ten years in traffic and income.

Admittedly this estimate possesses the uncertainty that four of the bond issues are not yet legally authorized. However, in each state empowering legislation barely failed to pass the legislature last winter because opinion had not crystallized on the preferable method of financing. In no state of the four was public sentiment against comprehensive improvement or averse to heavy expenditures for such improvement. In brief, the most intelligent observers of the trend of thought in highway matters in each state express confidence that at another session of the legislature, if bonds are not authorized, some adequate means of financing an equivalent public roads development will be provided.

There is clearly enough a situation, under the circumstances outlined, which concerns engineers, contractors and manufacturers deeply in a business way and which affects largely the construction-economic direction of public works policies. To present this situation particularly as it interests the engineer, contractor and manufacturer and incidentally in its broader economic aspects, an editorial survey has been made on the ground, from which certain conclusions may be formulated.

Each state of the group has its special problem. In North Carolina, West Virginia and Missouri, the three states whose systems are financed, the problems are progressive construction of improved roads and current maintenance. Virginia has a problem in methods of financing. In South Carolina a lagging disposition adequately to finance road improvement has to be overcome by education. Education again is the problem in Tennessee, but here in road administration policies. Kentucky has a complicated problem in recovering from county control. Virtually all of these problems exist to some extent in each state; together they constitute the group problem of the mid-southern states.

Area and Population—In round figures the group has

an area of 300,000 square miles and a population of 16,000,000. The average population per square mile in no state of the group varies more than five persons from the group average population of 53 per square mile. In the seven mileage-producing states contiguous at the north and including Michigan the area is nearly the same and the population is twice as great.

The two outstanding characteristics of highway development in the mid-southern group of states are:

1. Highway improvement has for its purpose, more than in the North, the development of territory and creation of traffic.

2. For each dollar spent in road improvement there is a greater charge than in the North on each individual and each unit of property value.

In undertaking the expenditures which have been indicated these states are therefore evidencing an appreciation of transportation value and a boldness in investing for its attainment which are not surpassed in the older road building states of the North. This should be set down, it would seem, as the *first fundamental group characteristic* in highway development of the mid-southern states.

Present Status of Highways—These states have no systems of modern roads. They all have improved roads in isolated stretches leading out from centers of population but no considerable mileage of connected and correlated roads. In a measure these statements should be modified in respect to North Carolina and West Virginia, which for two years have been actively building modern roads and are approaching completed systems, but they accurately represent the conditions in these two states at the beginning of construction two years ago. Creation of state road systems virtually from the beginning—for the nucleuses of existing improved roads is scarcely important—is the *second fundamental characteristic* of the group.

Production of a maximum mileage of road usable throughout the year except for a few weeks of the worst weather is the essential road development task. This is well understood by the state highway officials and appears to be sensed in a considerable and increasing measure by business and industrial leaders. It is planned to be secured in two principal ways:

1. Progressive construction, or rapid construction first of permanent grade temporarily surfaced, to be improved later, as traffic develops, by paving.

2. Intensive maintenance, established over the entire system so as to give highway service, prior to construction, in every part of the state.

At present North Carolina is the high exemplar of these practices, but Missouri is following closely and the beginning is apparent in the other states. It is a fair conclusion that the *third fundamental group characteristic* is progressive construction and immediate full-mileage maintenance.

Topographic Conditions—Five states of the group—the two Carolinas, Virginia, Tennessee and Kentucky, are remarkably similar in general topography. In the three seaboard states there is a low coastal plain rising to a higher plateau known as the Piedmont region, and in the west a rugged mountain section. Tennessee and Kentucky have their mountains in the east and from them a rolling plateau sweeps west and gradually descends to the Mississippi River. In these states the highest development is in the plateau region, except for a few important coast and river cities. West Virginia is uniformly mountainous with no marked regional divisions of topography. Missouri is hilly upland, with a marked mountainous district of the Ozarks and an equally pronounced river bottom area in the southeast.

It follows from these topographic conditions that there is an outstanding group problem of regional planning of highways. This problem shows several phases of which two attract most attention. One is the varying engineering task of mountain construction involving heavy earth and rock excavation; upland construction in industrial and agricultural country where traffic introduces a surfacing problem, and low-land construction complicated by stream crossings and overflow conditions. These are tangible difficulties, which is not true of the difficulties of the other phase of the regional planning problem, namely, sectional jealousy growing out of the provincialism of previous county control of all highway enterprise. It is fair, then, to call the *fourth fundamental group characteristic*, a problem in regional planning.

Financing and Public Sentiment—It is this lingering idea of county rights which has obstructed state financing, although in general the main reasons for delay are: (1) Doubt whether such large expenditures can be afforded and (2) debate whether a bond issue or a pay-as-you-go policy is the sounder method. Public sentiment in practically every state of the group favors improvement on an extensive scale, but it is undetermined as to the wisest method of financing. Everywhere, unfortunately, discussion is tinged with partisanship, which is forgetting the economic and business question in the determination to win personal victory. This situation, however, is largely incidental and may be overlooked in the certainty, which observation indicates, that education is crystallizing public opinion. A public going to school in highway affairs is almost the first impression one gets of the present situation in the border-line states of the South.

Turning to the proposed plans of financing, whether an issue of bonds or a pay-as-you-go method is considered, resort to a general tax is nowhere being advocated. Indeed great effort is being expended to kill any suspicion that general taxes will be increased by intensive road building. The money is to come from automobile license fees and gasoline taxes, and such other taxes as now exist. Six states of the group, all except Missouri, now impose a tax on gasoline: 3c. in South Carolina, North Carolina and Virginia; 2c. in West Virginia and Tennessee, and 1c. in Kentucky, an average rate of 2½c. a gallon, which is well above the average rate for the country. The *fifth fundamental group characteristic* is then, that the automobile is to be made to pay for road improvement.

Road Types—There is no group characteristic in road types except that maximum immediate construction of permanent grade surfaced with selected local soil is contemplated. Paved roads are of all the types common elsewhere except that Kentucky rock asphalt has greater use in these mid-southern states.

Recapitulation—The elements which feature the highway problem in these seven states as a group are: (1) Construction primarily to develop territory and create traffic; (2) Provision of immediate highway service by full-system maintenance and quantity production of permanent grade temporarily surfaced; (3) Regional

planning required by the distinct mountain, upland and bottom land sections of each state; (4) Development of financing plans without general property taxation; and (5) Public education in highway economics and administration.

The Two Carolinas

THE TWO Carolinas are far apart in their progress in road improvement. North Carolina ranks perhaps as the most advanced state of the South. In system development West Virginia will probably challenge this claim and Missouri certainly is running ahead in mileage under contract. South Carolina has not been in a position to do what the other states have accomplished. It has limited funds which have to be widely distributed according to county allotment so that both system development and intensive construction have been impossible.

In population and area the Carolinas are quite different. They are closely similar topographically. Both have the coastal plain, the Piedmont uplands and the mountain region, each having its characteristic development and all together presenting the problem in regional road planning which is a group characteristic of the seven mid-southern states. They are alike too in having extended areas of "top-soil," which is one of the most valuable of the natural road surfacing materials. Altogether the problems of the physical development of roads are similar in the two states.

South Carolina

Mobilizing for Highway Development

South Carolina is a state making ready for the period of intensive road improvement which it knows is approaching. Evidence of this appears in economic studies and formulation of plans by the state highway commission and in the inauguration of definite legislation for a bond issue and for centralizing authority in the state and carrying this legislation over to a succeeding regular session, thus protracting the period of discussion preceding action.

With a very determined public opinion that more definite highway development is required, there is no definite popular thought on ways and means. This is more true of questions of finance and administration than of those of amount, location and type of road. There are, among those who are looked to for formative planning, factions favoring (1) centralized state administration, (2) complete county administration and (3) joint state and county administration. Both a bond issue and the pay-as-you-go plan of financing have their advocates. Taking their cues from their leaders, the run of persons uphold this or that plan as may happen.

Of the bills put before the Legislature last winter, one called for a referendum on a $60,000,000 bond issue to be financed by increased automobile license fees and a gasoline tax, and one specified a state highway system to be constructed and maintained without regard to county boundaries. Both bills were passed by the senate and after consideration in the house were carried over to the next session. It is a fair presumption that the postponement was wise, since a bond issue would be certain to be defeated by popular vote with the people in their present undetermined state of mind, and that an interim period of thought and discussion will help to formulate and stabilize public opinion.

Meanwhile the engineers of the highway commission are formulating tentative engineering and economic policies. As a starting point three classes of public roads are being considered:

1. Those connecting the farm and market which are or ought to be, it is thought, of sufficient local interest to be paid for wholly out of local funds.

2. Those connecting every market of consequence in the state directly with the next larger markets so as to get a connected system of inter-market roads. These roads, it is considered, are of interest to the entire state, and should be paid for at least in large part by the state.

3. Those roads connecting the principal centers of this state with the principal centers of other states. These are of national significance and ought to be paid for at least in part by the nation.

With 52,000 miles of public roads it is estimated that between 8 and 9 per cent, or from 4,000 to 4,500

FIG. 1—APPROXIMATE DISTRIBUTION OF HIGHWAY TRAFFIC IN SOUTH CAROLINA

miles, will eventually have to be included in the state system "if all centers where farm products are marketed in sizeable quantities are to be connected adequately." The present system, as of Jan. 1, 1923, includes 3,519 miles. Type of improvement and its cost have been carefully considered.

Tests made by the department engineers indicate savings up to 50 per cent in gasoline consumption between operating a motor vehicle on fair earth roads and on pavement. Between average unimproved earth roads and the better sand-clay and top-soil roads the saving may run as high as 30 to 40 per cent. Assuming that sand-clay roads cost $5,000 and paved roads $30,000 a mile, Charles H. Moorefield, state highway engineer, speculates on the problem as follows:

"If only 1c. per vehicle-mile is saved, 100 vehicles per day would mean a saving of $360 per mile per year, which would pay 5 per cent interest on $5,000 and leave over $100 per year to help with the maintenance. One thousand vehicles per day would mean a saving of $3,600 per mile per year and would justify any sort of pavement. The actual saving, in cost of operation, of course, would be much more than 1c. per mile as between an average unimproved earth road and a good sand-clay road, particularly if the latter is well maintained. In fact it is estimated, from such information as is had, that the average cost of operating a Ford automobile is approximately 10c. per mile for the unimproved roads in good weather, 6.5c. per

mile for well maintained sand-clay, top-soil and gravel roads, in any ordinary weather, and for a paved road, about 5.5 to 6c. per mile. For other makes of automobiles the relative difference in cost of operation is about the same.

"If these figures are accepted as showing the relative operation costs and the construction cost is estimated as already mentioned, it is apparent that in general 50 vehicles per day would justify a sand-clay or top-soil surfacing with an expenditure of $300 or $400 per mile per year for maintenance, and between 500 and 1,000 vehicles per day would justify a pavement.

"From such traffic counts (see Fig. 1) as have been made, there are about 1,200 miles in the present state highway system where the traffic has already reached or is approaching the point where hard-surfacing becomes economical and of this about 200 miles have already been paved. Every mile of the remaining system not already improved can unquestionably be improved economically as sand-clay, top-soil, or gravel roads. There are about 2,000 miles of such roads already and at least 2,000 miles in addition are necessary to complete the systems."

As a construction program to meet the minimum highway requirements of the state the following has been laid down:

1. Two thousand miles of sand-clay, top-soil and gravel, to be completed in three years, at an average cost of $6,000 per mile, allowing for some gravel to be transported by rail, or a total for this item of $12,000,000.

2. One thousand miles of pavement to be completed in 6 or 7 years at an average cost of $28,000 per mile, or a total for this item of $28,000,000.

3. Major bridge projects to be built as the sand-clay system develops, or within 3 years, at a total cost of about $5,000,000.

This adds up to a minimum construction program of about $45,000,000 during 7 years. About $1,500,000 per year would be needed for maintenance in addition to the funds for construction.

Two fundamental thoughts stand out in this speculative planning; one is progressive construction and the other is the use of top-soil surfacing. In North Carolina both practices have been perfected to a degree which makes their adoption logical in a state having so much the same conditions as South Carolina.

North Carolina

Constructing Roads Progressively

Intensive highway development is in progress in North Carolina. Construction with the bond issue money began in April, 1921. On Jan. 1, 1923, there had been completed on the state system 137 miles of paved road and 676 miles of graded and surfaced road. There were under contract at that date 850 miles of paved road and 931 miles of graded and surfaced road. The plans for 1923 contemplate putting 800 miles of road under contract, about half had been let on May 1. So many activities are involved in a program of this size that a general review would largely defeat any good purpose.

North Carolina stands out in highway affairs for its efficient administration, its plan of progressive construction and its full-system maintenance irrespective of condition of improvement.

There is complete state administration of both construction and maintenance. The chart Fig. 2 shows the organization adopted. It is not merely in its powers and its mechanism, however, that administration exhibits its quality. An excellent personnel has been secured and a team morale developed which are pushing through one of the most remarkable of the many notable state highway programs of the time.

Progressive construction has been expanded so often in the last year or two that little remains to be said of its theory or practice. In North Carolina it has been developed as an official plan more purposefully perhaps than in any other state. As described by Charles M. Upham, state highway engineer:

"The North Carolina method of progressive type construction is to grade the road, using the same standards for line and grade that are used in hard surface construction. Only one standard of drainage structures is used, regardless of whether the road is merely graded or is to be covered with a hard surface. This construction of

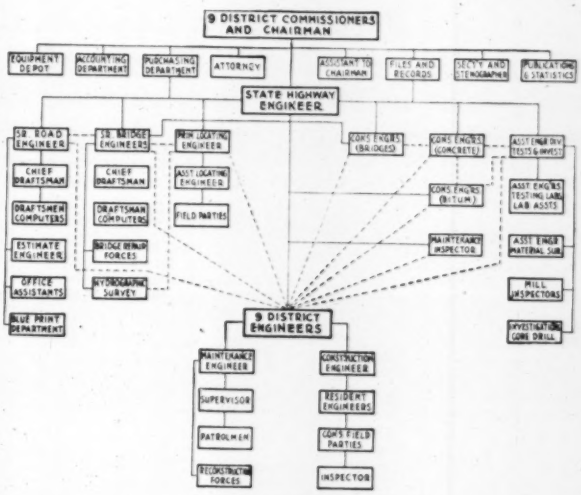


FIG. 2—NORTH CAROLINA HIGHWAY COMMISSION ORGANIZATION CHART

graded road will care for the light traffic which generally exists in all newly developed localities. This graded road is at all times maintained and when the increased traffic creates a high cost of maintenance, then it is time to construct the next higher type of road surface. The next step in the progressive type road is to cover the graded road with a selected soil material such as sand-clay, top-soil or gravel. This material is generally of higher bearing value than the natural soil and is a material which is less affected by moisture and, therefore, more suitable for use as a road surface. This selected surface material is maintained as a subgrade highway until such time as the maintenance cost becomes excessive and the increased traffic indicates that a hard surface roadway is necessary.

"The cost of grading and of the drainage structures generally constitutes about one-sixth of the ultimate cost of a hard surface road. To add a selected soil surface adds very little to the cost of this construction. Consequently about six times as much road, with a selected soil surface, may be constructed for the money that would be spent for the immediate construction of hard surface roads. This makes it possible for transportation to be benefited to a much greater extent and the state to develop at six points rather than at one. It will be noted that the construction of the selected soil surface is an addition to the graded road, and no previous step in the grading or construction of drainage structures has been lost or thrown away in the construction of this selected soil surface road."

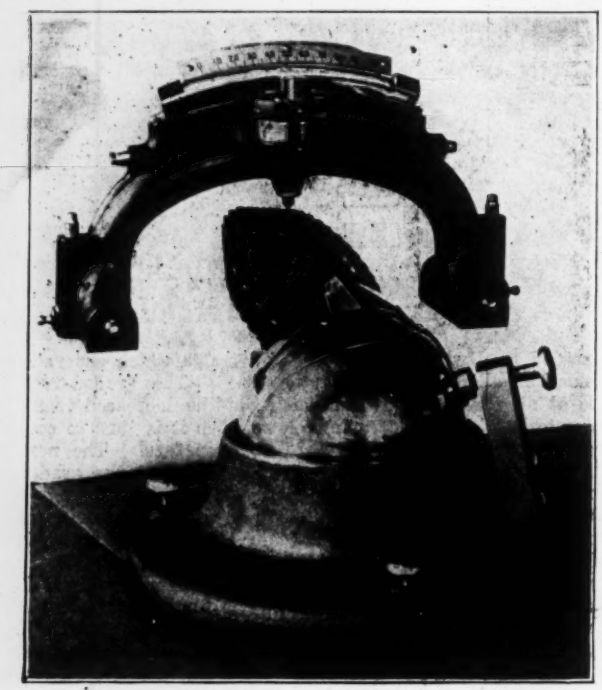
Quick extension of road service to the people, which is one of the fundamental objects of progressive construction, was again a fundamental thought in planning full-system maintenance and putting practically all state roads under intensive maintenance whether improved

or not. In the matter of the working out of the theory of immediate full-system maintenance without respect to the progress of construction, Frank Page, chairman of the North Carolina Highway Commission, says:

"It has been demonstrated by North Carolina's assuming control of a large mileage of highways for improvement and by the establishment of immediate intensive maintenance that the public at once realizes something is being done. The adoption of the combination patrol and gang system of maintenance, employing motor trucks and tractors for all operations, demonstrated to every section of the state that results were being accomplished every day. The same standard of work and uniformity of practice was maintained throughout the entire state, and, combined with the tremendous extent of the operations, gave immediate and better service to traffic and satisfied an impatient and jealous public which did not expect to see the results realized in so short a time."

A New Method of Testing Hardness

A HARDNESS test differing quite radically from existing tests based upon scratching or penetration of a ball or a sharp point has been worked out by Edward G. Herbert, Ltd., of Manchester, England. An instrument called the Herbert pendulum hardness tester



HARDNESS TESTER APPLIED TO A CUTTER

is being built and sold by them for the purpose of the new tests. As indicated in the view herewith, the instrument consists of a bow-shaped weight, adapted to swing as a pendulum on a point support provided at the center of the bow. At this support the bearing is a 1-mm. ball of either ruby or hardened steel. On top of the bow is mounted a spirit level.

With this instrument two kinds of test are possible. What appears to be the preferred test of the makers is called the time test. In this, the instrument, placed with its bearing point on the surface to be tested, is given a very gentle impulse so as to oscillate on its support; the time, in seconds, of ten complete oscillations is taken as the hardness number. From a statement by the makers, an empirical relationship between the hardness figure found in this time test and the Brinell hardness number has been established by tests, as follows: For time-test numbers T below 33⅓, the Brinell number is $0.3\,T^2$, while for time-test numbers over 33⅓, the Brinell number is $10\,T$. The time of ten oscillations on glass is 100, so that the time-test hardness number for glass is 100. This is with a length of pendulum (height from bearing surface of ball to center of gravity) of 0.1 mm.

A test of another kind may be carried out by tilting the instrument to one side until the level bubble is at zero on the scale, and then releasing it. The reading of the level bubble at the end of the first swing is taken as the hardness number. In the case of glass this figure is 97, while annealed carbon steel gives 41, soft cast brass 4, and lead 0.

In the photograph herewith the instrument is shown applied to a cutter whose hardness is to be tested. The cutter is held in a ball-and-socket adjustable vise which is built by the makers for use with the instrument.

Streets of Canterbury in the Days of Henry VIII and Elizabeth

FOR the benefit of Canterbury pilgrims and residents after the days of Chaucer, or in the reigns of Henry VIII and Elizabeth, street lighting, watering, and cleaning at private expense, and scavenging at public expense, were ordered in the following terms, according to excerpts from Bunce's manuscript abridgement of the minutes of the Courts of Burghmote, cited by P. H. Warwick, city surveyor and engineer, in a paper on "Roads of Canterbury, Ancient and Modern," read before a district meeting of the Municipal and County Engineers and published recently in London *Surveyor*:

Street Lighting—Twentieth of November, 55th Henry 8th. From henceforth during Winter every dark night the Aldermen and Common Council and every Inn holder shall severally find one candle will light at their doors on pain of forfeiting 6d., and the other inhabitants are to do in like fashion upon reasonable request under the same pain, and if any lanthorn shall be stolen the offender shall be set on the Pillory by the discretion of the Mayor. The candles are to be lighted at 6 o'clock, continue till burnt out.

Street Cleaning—Sixth November, 35th Henry 8th. The inhabitants of the city are from henceforth to keep clean their pavements belonging to their houses on every Friday or Saturday, and are to carry away the Dung from the pavements to a common place theretofore ordained called the Black Dyke, and no persons are to lay any Dung under their walls on pain of 2d., one half to the Chamber and the other half to the Officer assigned on. The penalty is to be levied by distress.

Street Watering—Fourteenth July, 32nd of Elizabeth. In course of the hot weather every inhabitant of the city is to water the street adjoining his house on pain of 3d., to be levied by distress.

First Scavengers—Eleventh March, 42nd of Elizabeth. The Mayor and Aldermen are to provide a Scavenger or Scavengers for cleaning of the streets, who shall be paid their wages by a taxation on the inhabitants.

Water Costs More Than Doubled at Reading

The cost of supply water at Reading, Pa., increased from $15.62 per million gallons in 1913-14 (April to April) to $32.82 in 1921, according to the latest published report of Emil Nuebling, chief engineer of waterworks. The figures given include all maintenance, but no capital charges. Pumping costs increased from $5.97 to $15.50 per million gallons. The revenue per million gallons was $48.41 in 1913-14 and $45.13 in 1921.

Flood Relief Plans for Red River of the North

Interstate Relations Complicate $6,000,000 Plans for Detention Lake and Improving 400 Miles of Winding Channel

PREVENTION of overflow from a sinuous river channel and drainage of flood waters from the adjacent lands are the main points of a project for the protection of the valley of the Red River of the North, where increasing settlement makes the periodical flooding increasingly serious. Some form of interstate organization will be necessary for carrying out and supervising the project effectively, since Lake Traverse, at the head of the river, forms part of the boundary between Minnesota and South Dakota, while the river forms the boundary between Minnesota and North Dakota. Channel improvement being one of the main features in the project, maintenance of the channel in its improved condition will be essential to success and will be one of the problems for solution by whatever supervisory body is organized.

This flood control and drainage problem has been the subject of an extended investigation by the U. S. Department of Agriculture, under the direction of S. H. McCrory, chief of the division of agricultural engineering. The accompanying review of the situation is prepared from a report by P. T. Simons, senior drainage engineer, and Forest V. King, drainage engineer, who have been in charge of the investigation. A preliminary report, dealing with the special features involved at Lake Traverse and the upper end of the valley, was summarized in *Engineering News-Record* of July 29, 1920, p. 225.

The Red River of the North heads practically in Lake Traverse on the western line of Minnesota and flows north to the Canadian boundary, continuing to the city of Winnipeg and discharging into Lake Winnipeg. The problem of the Canadian portion of the river was discussed in *Engineering News-Record*, April 20, 1922, p. 657. The river is fed by numerous tributaries and its drainage area and the main streams are shown in Fig. 1. The south end of Lake Traverse is closed by a low and narrow divide, separating it from Big Stone Lake, which is at the head of the Minnesota River flowing southeast to the Mississippi (see *Engineering News-Record*, July 28, 1921, p. 140).

Although the course of the Red River is due north its channel is so extremely winding that its length from the Lake Traverse outlet to the Canadian line is 456 miles, or about double the straight line distance. This typical condition is shown in Fig. 2. For the first sixty miles the stream is known as the Bois de Sioux River, the Red River proper beginning with the junction of the Bois de Sioux and Otter Tail rivers near Wahpeton, N. D

Red River Valley—A plain 15 to 30 miles wide flanked by steeply rising ground forms the drainage area of the river, with 35,895 square miles south of the Canadian line. Owing to natural drainage there is comparatively little swamp land in the plain, except along the Bois de Sioux River. Not more than 10 per cent of the drainage area is forested and about 80 per cent of the prairie and cleared land is under cultivation, the remainder being mainly grazing land and town sites. The soil is largely clay and loam.

In this broad and nearly level valley the flood water has very little current and the depth is not great even with a heavy overflow. But it causes damage to property, interferes with transportation and agricultural work and may result in greatly reduced crop yields. The river has an irregular flow and protracted periods of low water. Its fall is slight, the elevations of the ground surface on the banks being 980 ft. above sea level at Lake Traverse, 963 ft. at Wahpeton, 900 ft. at Fargo, 830 ft. at Grand Forks and 789 ft. at the Canadian line. The channel capacity is about 2,000 and 4,000 sec.-ft. just above and below Breckenridge, 6,000 ft. below the Dakota Wild Rice River, 12,000 ft. below the Sheyenne River, 15,000 below the Buffalo River and 25,000 sec.-ft. below the Red Lake River.

Rainfall and Runoff—Annual precipitation during the 38-year period including 1919 for the 25,755 square miles above Grand Forks has ranged from 12.21 in. in 1910 to 27.76 in. in 1916. On some subdivisions of this area higher figures have been reached, with a maximum of 35.2 in. on 4,225 square miles. The annual and monthly records of rainfall indicate that the maximum annual precipitation will not exceed 30 in. for the entire drainage area south of

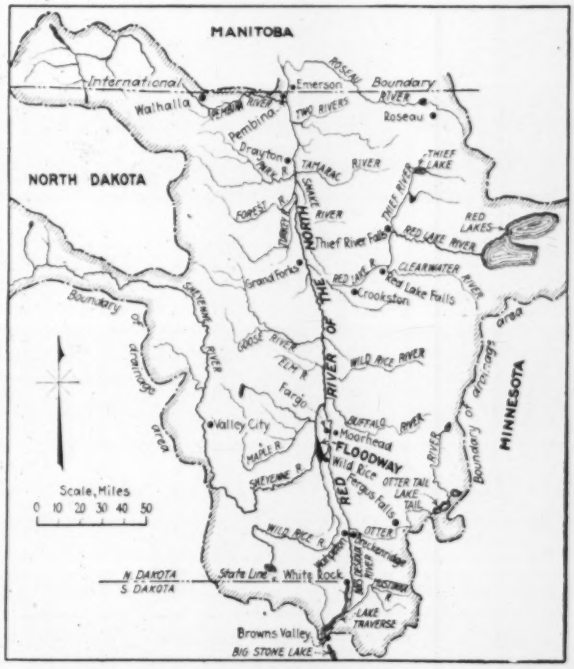


FIG. 1—DRAINAGE AREA OF RED RIVER OF THE NORTH

the Canadian line, 37 in. for areas of 2,000 square miles or more in the eastern section, 25 in. in the extreme western section and 36 in. above Fargo. These maximum conditions are not likely to occur more often than once in 50 to 75 years, and maximum precipitation on the smaller drainage areas is not likely to occur on all these subdivisions in one year.

Runoff records for this 38-year period show an annual runoff from the drainage area south of Grand Forks ranging from 23,590,000,000 cu.ft. in 1911 to 190,880,000,000 cu.ft. in 1897, with a mean of 90,870,000,000 cu.ft. and a mean rate of flow of 2,881 sec.-ft. The shape of the drainage area tends to produce quick runoff. Since the width is nearly equal to the length, the runoff from large portions tends to concentrate at certain points. Maximum monthly records of rainfall and runoff are shown in Table I. Drainage ditches do not materially increase the spring runoff from melted snow, because a majority of these ditches are obstructed by snow and ice so that they do not begin to function until some days after the melting of the snow on the drainage area.

Tributaries and Drainage Ditches—In the upper reaches of the tributaries the fall is much greater than in the Red River, but in the lower parts the fall is slight. Many of

these streams parallel the main river for a considerable distance before finding an outlet. The channels are sinuous and badly obstructed by vegetation. During heavy runoff the general condition is that of increasing bodies of water coming down obstructed channels of small and diminishing slope. These bodies finally unite in a common channel having the same characteristics, resulting in the overflow of large areas of flat land along the river.

Drainage ditches in the flat lowlands have but little fall and their efficiency depends largely upon the conditions of river flow. This drainage work is more extensive on the Minnesota side, where 41.3 per cent of an area of 4,391 square miles is within half a mile of ditches, while on the Dakota side the proportion is only 11.5 per cent for an almost equal area. The upland drainage systems have greater fall and free-flowing outlets. A condition which appears to be beyond relief is that many of the ditches

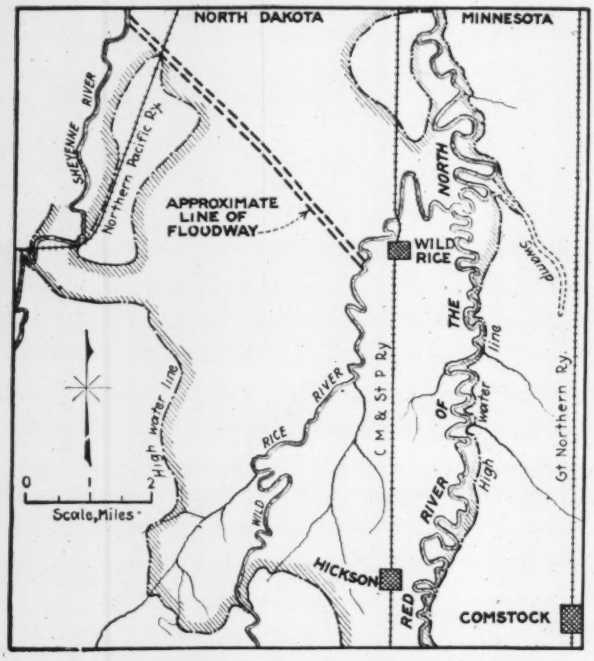


FIG. 2—PROPOSED FLOOD DIVERSION CHANNEL

To extend a distance of seven miles from the Wild Rice River to the Sheyenne River and to bypass flood water around Fargo. Note the winding course of the river.

are filled with snow and ice in the spring. Tile drainage is very limited as yet but it will accelerate the removal of water in the soil and thus reduce the bad effects of excessive moisture.

Snow and Ice Conditions — Snow accumulates on the drainage area in varying quantities from November to March, inclusive, and has an important effect on the runoff during March and April. For the highest flood on record (April, 1897) the average depth of snow just before the spring break-up was 26 in. and all of this melted in about twenty days. All the larger floods have been due to the melting of snow on the drainage area rather than to precipitation at the time of the flood, although in some cases the flood has been increased by precipitation. Nearly every year more than 25 per cent of the annual runoff occurs in April. This is owing to the melting of snow, as the April precipitation is usually less than 10 per cent of the annual precipitation.

With a northward flow through a region of low winter temperature and heavy ice, spring thaws begin in the upper portions of the watershed and move gradually downstream, causing the runoff from large areas to reach lower portions of the river when the ice is breaking up. This ice lodges against trees and other obstructions so as to retard the current and reduce materially the discharge capacity of the stream. Prof. Chandler's paper on "The Floods of the Red River Valley" (*Journal of the University of North Dakota*, 1918) states that in some cases this ice retardation has raised the water 2 to 7 ft. higher than would have been necessary for the same discharge capacity with a free channel.

TABLE I—MAXIMUM MONTHLY PRECIPITATION AND RUNOFF OF THE RED RIVER

Month	Precipitation Inches Max.	Year	Runoff: Billions of Cubic Feet Max.	Year
Jan.	1.57	1916	4.70	1906
Feb.	1.48	1908	3.48	1906
March	1.91	1902	22.60	1910
April	4.94	1896	81.92	1897
May	5.17	1896	42.72	1893
June	7.56	1915	32.48	1906
July	6.93	1897	30.40	1916
Aug.	7.40	1900	19.20	1897
Sept.	4.52	1900	11.70	1905
Oct.	3.20	1901	16.58	1900
Nov.	2.33	1896	13.64	1900
Dec.	1.52	1909	6.49	1909

TABLE II—STORMS IN RED RIVER VALLEY

Duration, Days	Precipitation, Inches Total	Max. in 24 Hours	Date
3	11.10	10.75	July, 1909
8	10.50	3.15	Aug. 1900
4	9.02	4.92	July, 1919
4	8.18	4.31	Aug. 1899
6	7.42	5.86	July, 1897
6	6.93	5.85	Aug. 1908
4	6.13	5.30	June, 1919
3	5.04	3.95	June, 1915

With a northward flow through a region of low winter temperature and heavy ice, spring thaws begin in the upper portions of the watershed and move gradually downstream, causing the runoff from large areas to reach lower portions of the river when the ice is breaking up. This ice lodges against trees and other obstructions so as to retard the current and reduce materially the discharge capacity of the stream. Prof. Chandler's paper on "The Floods of the Red River Valley" (*Journal of the University of North Dakota*, 1918) states that in some cases this ice retardation has raised the water 2 to 7 ft. higher than would have been necessary for the same discharge capacity with a free channel.

Storm Records—For the 26-year period 1894-1919 there were 130 storms with a precipitation of 2 in. or more in 24 hours. Of these, 62 were in June-July, 30 in April-May, 31 in August-September, 2 in March and 5 in October. In duration, there were 41 storms of three days each, 38 of four days, 18 of five days, 17 of six days, 8 of seven days, 7 of two days and 1 of eight days. Eight of these are noted in Table II. The storm of July, 1897, covered the entire drainage area and was the maximum storm of such wide extent.

Storm precipitation during the summer often has a marked effect on the runoff, this effect being relatively greater on the drainage areas of tributary streams because the most intense precipitation occurs in comparatively small areas. Storms sometimes cause maximum runoff on drainage areas up to 10,000 square miles, but on the larger areas, such as that above Grand Forks, the spring runoff due to melting snow is the greater.

Flood Conditions—Serious spring floods due to rain and melting snow occur at intervals of one to fifteen years along the Red River north of Wahpeton. From May to October local floods are caused by storms of very heavy rainfall over areas up to 6,000 square miles. Seven times during the 40-year period including 1920, the Red River at Grand Forks rose above flood stage (El. 819.5 or 40 ft. on the gage of the U. S. Geological Survey). In each case this occurred soon after the spring thaw. High stages occurred in the two consecutive years 1882 and 1883, but the longest period between flood stages was twelve years, 1904 to 1916. Only two of these seven floods were serious throughout the entire valley. Some have been most serious below Grand Forks, but that of 1916 was most serious around Fargo and in the upper parts of the valley.

Conclusions based on the records are as follows: (1) A serious flood may occur in any year; (2) the probable frequency is one in fifteen years; (3) the largest probable interval between floods is thirty years.

Recommended Improvements—From the study of the situation it is evident that adequate drainage of the wet and overflowed lands in the valley will require control or reduction of the floods and the provision of ample drainage ditches to remove excess water rapidly from these lands which have insufficient natural drain-

age. The work divides naturally into three parts, which can be carried out separately or as one large project: (1) Lake Traverse and the Bois de Sioux River; (2) the Red River; (3) the Red Lake River.

For the first section, it is proposed to develop Lake Traverse as a detention reservoir by means of a dam at the outlet and a levee at the south end; also to excavate a new direct channel for the Bois de Sioux and to provide a system of drainage ditches (see *Engineering News-Record*, July 29, 1920, p. 225).

Channel improvement and one stretch of stream diversion are the main features of work proposed along the Red River. It is only during times of excessive runoff that flood stages occur and a relatively small reduction of the high stages would prevent overflow. In the opinion of the authors of this report there is no opportunity for detention reservoirs, while levees from 5 to 20 ft. in height along the river and its numerous tributaries would be of prohibitive cost. To relieve the flood flow at Fargo, it is proposed to construct a wide and shallow floodway with a capacity of 2,250 sec.-ft. from the Wild Rice River near Wild Rice, N. D., to the Sheyenne River, a distance of about seven miles. The approximate route of this floodway is shown in Fig. 2, but no definite location has been made. In this way, high stages of flood water would be bypassed around Fargo and discharged below that city by the Sheyenne River. There would be a concrete inlet sluiceway, with gates, but the channel would be formed with gentle slopes so as to be used normally for pasture.

In improving the main channel, its enlargement and the construction of cutoffs are both impracticable, owing to the enormous amount of excavation which would be required and the difficulty of disposing of the material. The most economical and effective plan is considered to be that of clearing the channel of the numerous obstructions which retard the flow and are largely responsible for overflow. Throughout its length the channel is more or less obstructed by trees, brush, bridge piers and other structures, refuse dumps and débris. This condition is shown clearly by the typical cross-sections in Fig. 3, these sections including the normal open channel and the restricted channel at bridges. Particular attention is called to the narrow section at Fargo, which indicates the desirability of bypassing the floodwaters around the city by means of the relief channel noted above.

For the 394 miles from Wahpeton to the Canadian line it is suggested that the entire high-water channel should be cleared of all obstructions except bridges. To maintain this condition it will be well to utilize that part outside of the flow line for pasture or hay. Many of the bridges are old and new ones should span the entire channel and be placed above high-water level. The high-water channel would include from 100 to 200 ft. on each side of the present low-water channel, giving a total cleared width of 300 to 600 ft

Red Lake River—An important factor in the Red River flow below Grand Forks is the flow from Red Lake and the Red Lake River. Except for high rolling land at the south, the lake of 441 square miles is in low flat country. The high-water level of the lake is 1,177 ft. or 4 ft. above low water. A project developed by the U. S. Engineers provides for limiting the range to 3 ft. by a control dam giving a maximum elevation of 1,174 ft. This dam would have concrete floor and piers with stop-log sluices between the piers. The present ill-defined channel below the lake would be improved for a distance of 45 miles. By thus lowering the lake level, local flooding would be prevented and drainage facilitated, while the increased flow would benefit present and future water-power plants on the Red Lake River.

Cost of Improvements—The estimated cost of the entire project is $6,179,000 at 1920 prices. This amount is distributed as follows: Dam and sluices at Lake Traverse, and new river channel and drainage ditches along the Bois de Sioux, $1,400,000; channel clearing along the Red River, $3,395,000, with $250,000 additional for extending the work 30 miles beyond the Canadian line to make the improvement fully effective; Wild Rice River floodway, $355,000; Red Lake and Red Lake River improvement, $779,000.

Possibility of flooding now makes the farming of large areas of the valley impossible or hazardous, and overflows which do occur interfere with urban activities and transportation. In the great flood of 1897 the loss was estimated at $7,000,000 and a similar flood at the

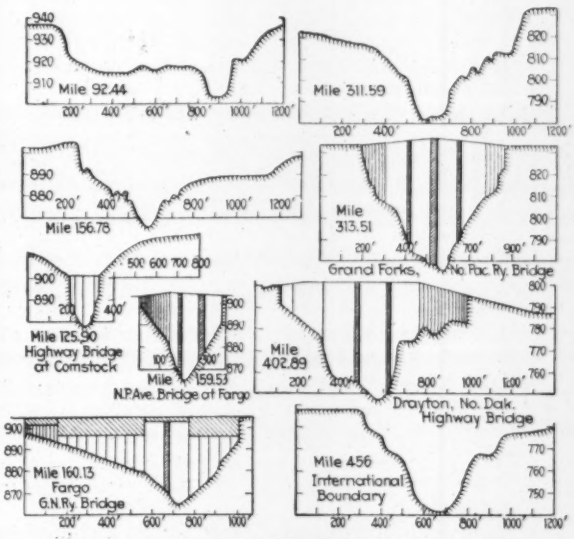


FIG. 3—TYPICAL CROSS-SECTIONS OF RIVER
Note restricted and obstructed channel at bridges.

present time would cause much greater loss. It is considered that these unfavorable conditions can be eliminated by the proposed improvements, which would lower the flood level by 5 ft. or more. Further, the benefits to be derived would warrant considerably greater expenditure than will be necessary for relief.

Organization—For this interstate project it would be necessary under existing State laws for organizations in the three states to enter into an agreement as to the distribution of cost. To insure satisfactory results it is essential to have a definite centralized control during construction and for subsequent maintenance. One plan suggested in the report is for each state to organize a drainage district including the lands benefited. The officers of these districts could then meet as one board having charge of the project as a whole. As an alternative, it might be possible to enact legislation providing for a joint commission. In any case, legislative action should provide authority for maintenance of watercourse channels, since lack of such authority has resulted in damage due to channel obstruction and ungoverned flow.

North Dakota Reservoir Project—A system of reservoirs and other works for control of floods of the Red River is proposed by Herbert A. Hard, chief engineer of the North Dakota Reclamation Commission. In a recent report he states that the losses during the three flood years 1915-1917 amounted to $50,000,000 and that the total cost of reservoirs, canals and controlling works will be about half that sum. This work by the State is being planned to meet the terms of the U. S. War Department. Impounding reservoirs are proposed at Lakes Traverse, Tewaukon, Ottertail and Red, at three points on the Sheyenne River and on the Pembina River west of Walhalla. The following is from a statement submitted by Mr. Hard.

An intensive survey has been made of the Sheyenne River gorge, especially for a hundred miles from Valley City to the headwaters. This narrow gorge varies from 100 to 250 ft. in depth and from 1 to 2 miles in width at prairie rim. The flood plain varies from a few rods to a mile in width. The gradient varies from 1 to 3½ ft. per mile. A stadia survey covered the entire gorge. Topographic maps are complete, as are preliminary designs for the proposed control dams, which are to be of the earth fill type with puddled clay core and concrete controlling works and spillway.

Taking as an example the dam ten miles north of Valley City, designs were made for heights of 50 and 60 ft. The valley floor is at El. 1239. A dam with spillway crest at El. 1280 will contain over 630,000 cu.yd. of earth and, with its concrete culvert, spillway, etc., will have an estimated cost of $344,134, exclusive of land and damages. This will give reservoir capacity of about six billion cubic feet and will afford relief from floods for the lower Sheyenne and Red valleys. For the Wild Rice River, a small dam at the outlet of Lake Tewaukon would partly control the flood stages and reduce the crest at Fargo. Alternative designs for dams 6 and 8 ft. in height have been prepared, with costs of $8,000 and $20,000 respectively. At this reservoir, as well as at Lake Traverse and Red Lake, there would be very little damage by flooding of surrounding lands.

The state and federal reports recommend a dam near the outlet of Lake Traverse, which lake is 30 miles long and from 1 to 3 miles wide. It can be made to impound 12,000,000,000 cu.ft. of water and will remove the flood menace of the waters of the Mustinka River, Minn., which caused much of the loss in 1915-1917. That loss became the basis of the $1,500,000 damage suit brought by the Dakotas against the state of Minnesota. The federal estimates, made during the war, are $1,400,000 for the Traverse project or $12.50 per acre of the lands protected. Estimates on improvement of the Red River channel from the outlet at White Rock to a point thirty miles north of the Canadian line are $4,000,000 or $8 per acre. The state has made no survey of the channel, but from the work on Lake Traverse prior to and during the federal survey, its post-war estimates are about two-thirds of the above values.

The War Department has made similar surveys of Red Lake and Red Lake River, Minnesota, and the state and federal engineers are in agreement on the efficiency of impounding reservoirs and channel improvements as means to avert floods in the afflicted valleys which have each caused losses equal in amount to the cost of all the improvement projects recommended.

Concrete Poles for Large Swedish Transmission Lines

Concrete Poles Produced by a Centrifugal Process Prove to Be Economical and Have Unusual Tensile Strength

By F. A. Brackmann
Berlin-Lankwitz, Germany

On account of the high price and the cost of maintaining iron structures, and the comparative short life of wooden structures, Swedish electric light and power companies have turned their attention to the development and use of concrete poles for transmission lines. The line from Trollhättan Falls in south central Sweden to Vaestreos, northwest of Stockholm, is the largest one on which they have been used. It is about 200 miles long and at present transmits current at 110,000 volts. It is intended to increase the voltage to 240,000 later on.

Eight hundred concrete poles produced by the centrifugal process were used in the construction of this line. They were erected in pairs. The first few hundred were

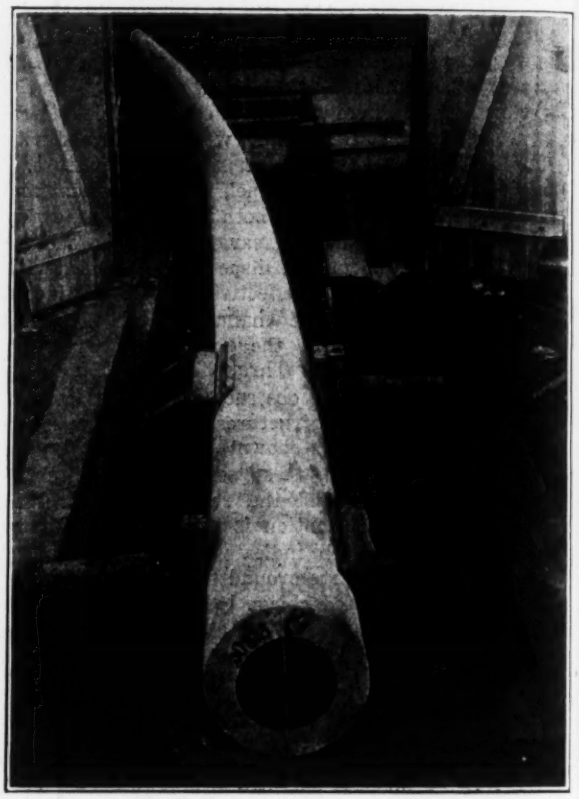


FIG. 1—TESTING ONE OF THE CONCRETE POLES
A pole 64 ft. long bent 7½ ft. out of line at the top without showing signs of failure.

connected by an iron transverse beam, but in view of the favorable result of tests made in the course of construction reinforced hollow beams were used later on.

These carry two cables between the poles and two at the ends outside. The length of the cross beam is about 54 ft., and the width between the two poles is 36 ft. According to the changing local conditions along the line, and the variations in the load from 1,200 to 1,400 lb., four different size poles were made, 56 to 59 ft. in

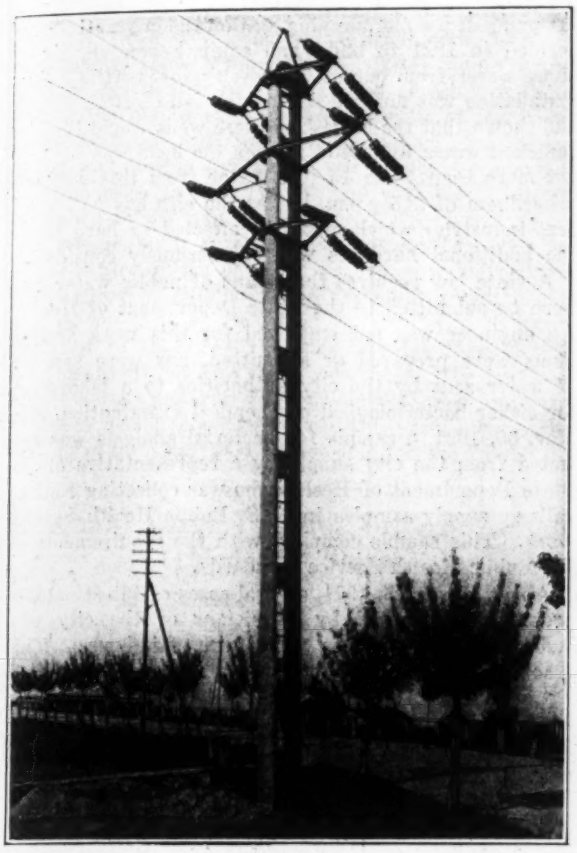


FIG. 2—A DOUBLE REINFORCED-CONCRETE POLE

A pole 61 ft. high on one of the smaller lines subjected to a top load of 10,000 lb.

length, and in diameter from 9 to 10 in. at the top, and from 18.5 to 23 in. at the bottom. The average thickness is about two inches. Nearly six per cent of them were tested, and some of them, about one per cent of the whole number, were subjected to bending stresses till fracture occurred. It was stipulated that the latter had to stand at least four times the highest ultimate load at the top. The others had to be subjected to double that load without showing any cracks or alterations of form.

The tests proved however that the poles were exceedingly elastic, and could carry six to eight times the highest ultimate top load. During the tests the load was taken off several times, and the top went almost completely back into its original position, showing that the bending was of an entirely elastic nature. In some cases when the breaking stress had been reached, cracks from the tensile stress outside the bend, and signs of excessive pressure inside the bend appeared at the same time, which shows that the tensile stress which centrifugal concrete will stand is considerably above the usual for concrete. Fig. 1 shows one of the poles, 64 ft. long, being subjected to a bending stress of 7,300 lb., bent 7½ ft. at the top without any signs of damage. The poles were tested at an age of six to seven weeks.

Of the poles and the beams which were manufactured at the works of a German firm at Cossebaude near Dresden, two-thirds were transported by rail the whole way, via the ferry Sassnitz-Trelleborg, and the rest were shipped by lighters from Stettin. Considering the great stresses to which the transport subjected them, it speaks well for their quality that all arrived in first-class condition.

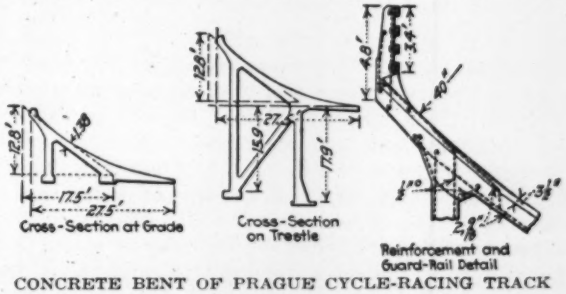
The poles are manufactured in a wooden mold, which is revolved in a special machine. The mold consists of two half-round forms, and is lined with sheet iron. The reinforcement is formed by rolled rods, of open-hearth material, placed longitudinally, which are interwoven with three spirals of wire one within the other. It is wound upon a special automatic machine, so that uniformity in the measurements of the spiral and in the strength of the poles is insured. The spirals influence the fracture stress comparatively little, but they determine to a certain extent the rigidity of the pole, and by using three spirals it has been possible to reduce the bending to ½ per cent of the length at the normal load, and to 1½ per cent at the double load. In order to give the maximum strength to the pole, care is taken that the reinforcement comes as close as possible to the circumference, and is at an equal distance away from it. Small slabs of concrete are therefore fitted to the outside of the reinforcement to keep it in the proper position within the mold. The cement mortar is mixed in proportion of one to three, and some asbestos fiber is added for additional toughness.

After the wire structure and the cement have been put into the mold, this is closed, and put into a machine which revolves it at a speed of 500 to 1,000 revolutions per minute, according to the diameter of the pole. The excessive water in the mortar accumulates in the hole in the center and in striking the wall of the pole during the revolving increases its compactness. The fear that the cement would be thrown to the outside, and that the mixture would become less rich towards the center has been proved unfounded.

After revolving the mold in the machine for about ten to fifteen minutes it is taken out, the lid at the end is removed, and the water is poured out of the center. The pole is left in the mold for one to two days. It has then set sufficiently to be taken out, and is kept in moist sand for about three to four weeks.

Concrete Motorcycle Track in Prague

A combined horse-racing and motorcycle-racing track was built recently in Prague, the cycle track being a concrete frame-and-slab structure surrounding the running track. This cycle track is of unusual design, as the cross-section herewith indicates. It has a measured length of 1,125 m., and is 8 m. wide on the straight and 9½ m. at the middle of the curves. The banking follows the curve of a cubic parabola, and is said to have been laid out for a maximum speed of 180 km. per hour.



CONCRETE BENT OF PRAGUE CYCLE-RACING TRACK

At the upper side the track structure continues vertically to form a protection rail, formed by four 3 x 6 timbers. The track is briefly described by Dr. J. Polivka, of Prague, in *Beton und Eisen* of May 20.

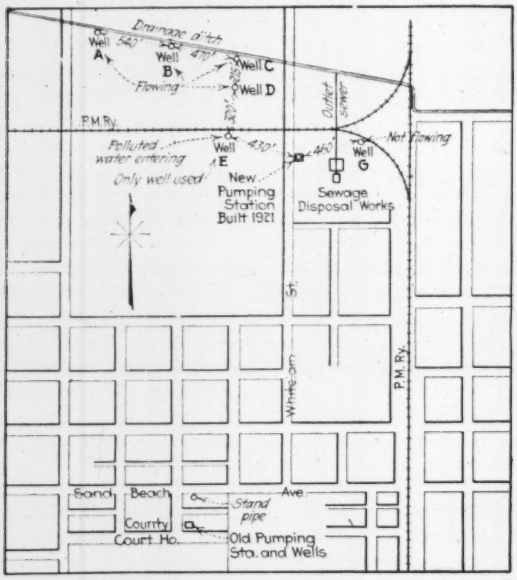
Underground Contamination of the Bad Axe Water Supply

Pollution Entering Unused Well 430 Ft. from Used Well Reached Latter Through Fissure Opened by Dynamite

By W. C. Hirn
Assistant Engineer, Bureau of Engineering, Michigan Department of Health, Lansing, Mich.

FORMATION of fissures by dynamiting wells probably is accountable for the pollution of the water supply of Bad Axe, Mich. The dynamiting took place several years ago but only recently have the dangerous conditions become possible.

Bad Axe is a city of 2,200 population, located in the upper part of the thumb section of Michigan in a level



RELATIVE LOCATION OF USED AND UNUSED WELLS AT BAD AXE

sandy lake bed area. In the vicinity of this city Marshall sandstone is the upper layer of the bedrock formation and is covered by only 30 to 50 ft. of glacial drift. The sandstone is several hundred feet thick. The upper layer is relatively free from water-soluble materials and furnishes water of a hardness of about 200 p.p.m. Previous to 1921 the city procured its water supply from three 6-in. wells, each about 150 ft. deep, located in the south central section of the city. These wells when first driven flowed a limited quantity of water. To procure a sufficient quantity for the city during recent years they have been pumped by air-lift.

Several years ago one 8-in. and six 6-in. wells were drilled in the northern section of the city to be used for supplying water to a proposed beet-sugar mill. These wells were drilled to a depth of 260 ft. and after drilling was completed a heavy charge of dynamite was exploded in the bottom of each well. The amount of dynamite used is not known, but an observer stated that water spouted up more than 50 ft. high from the explosion. The proposed sugar mill was not built and these wells were not used for several years. Persons living in the vicinity state that a considerable quantity of water flowed from them continuously.

Because of the excessive cost of operating the air-lift pump at the old pumping station the city authorities decided in 1921 to build and equip a new station to pump water from one of the seven unused wells. This installation was finished during the fall of 1921. Tests had shown that the largest of these wells would furnish sufficient water for the city when the head was lowered not more than 10 to 15 ft. Water from this well has a hardness of 315 p.p.m. but as the city has no important industries which might be affected by hard water the additional hardness was not seriously considered.

A state law requires that plans of public water systems be submitted to the State Department of Health. An engineer was not employed for this work and no plans were prepared or submitted, nor were samples of water sent by the city authorities to a laboratory for either bacteriological or chemical examination. On Nov. 30, 1921, a sample for bacterial analysis was collected from the city supply by a representative of the State Department of Health who was collecting routine railway supply samples in U. S. Public Health Service work. This sample complied with the requirements of the Public Health Service standards.

About March 25, 1921, several cases of intestinal disorders were treated by physicians of the city who judged that the sickness was a form of influenza. This trouble was not brought to the attention of the State Department of Health. Near April 1 a second epidemic of intestinal disorders developed which by April 8 affected at least 75 per cent of the population of the city. On April 12 the State Department of Health was notified of the trouble by the city authorities and was asked to send investigators to the city. A physician and a sanitary engineer were at once detailed to this work. On arriving in the city it was learned that the authorities had circulated handbills advising that all drinking water be boiled.

An examination of the new source of water supply was started immediately. Records showed that the casing of the 8-in. well in use extended down 40 ft. to rock. A screw cap was fitted to the top of this casing and a 4-in. suction pipe from the pump was screwed into the cap and extended about 40 ft. down into the well. All of the fittings appeared to be in excellent condition. To learn if the casing might be leaking a motor-driven air pump was borrowed from a garage and connected to a tap in the cap of the casing. An air pressure of 16 lb. was maintained after the air pump was stopped, which indicated that the casing and connections outside the suction pipe were free from leaks.

It was learned that the old source of supply had been used on different occasions for fire protection. The times when this was used seemed to correspond with the times of the outbreaks of sickness closely enough to direct suspicion in this direction and it was found that a small reservoir at this station was not properly protected against contamination. However, bacterial examination showed the water from the new pumping station to be grossly polluted but that from the old station to be free from contamination.

A further investigation was at once begun to determine the source of the pollution. Meteorological records from the U. S. Weather Bureau Station at Port Huron showed a rainfall of 0.76 in. on March 24 and 0.42 on March 27. These rains flooded a considerable portion of the area about the new pumping station. It was

found that wells marked A, B, C and D on the map were flowing. Well G was not flowing but water stood in the casing above ground level. After some inquiry well E was located in a large pond of water with the top of the casing submerged. On examination it was found that this well was not flowing but that surface water was flowing into it and was no doubt responsible for the gross pollution in the city well 430 ft. distant as shown on the map.

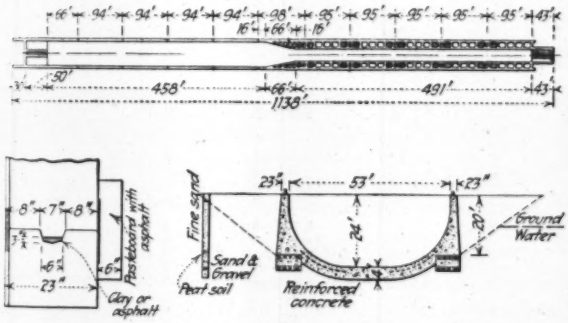
It would seem reasonable to assume that the fine dense nature of the Marshall sandstone would preclude any danger of contamination traveling a distance of 430 ft. but it is possible that the charge of dynamite exploded in these wells opened fissures through this formation. It has also been learned that in some places a very porous material lies between the upper and lower layers of Marshall sandstone and this porous connection may have been partially responsible for the trouble.

Unusually Large Tank for Testing Working Models of Ships

BY PROF. OTTO COLBERG
Hamburg, Germany

ONE of the most important pieces of reinforced-concrete tank construction carried out in Germany in recent years was the ship-testing tank built at the Hamburg Ship-Testing Institute during the war. The tank has a total length of 1,138 ft. and is built in two sections that can be used either independently or as one continuous tank. When used as one tank it is the longest tank of its kind in existence. The compartments are of different sections. The larger tank is approximately 53 ft. wide, 458 ft. long and 24 ft. deep, while the smaller tank is 491 ft. long, 26 ft. wide and 16 ft. 5 in. deep. The two tanks are connected by a conical tank 65 ft. long. Both tanks are used in testing models of different types of ships, the larger one being used for large models and the smaller tank or the combined tank being used to test small models.

The requirement for the test of models made it essential that the tank be waterproof and of as uniform a



PLAN AND SECTION OF HAMBURG SHIP-TESTING TANK

section as possible without any abrupt changes. In order to insure the tank against settlement, which might occur due to the unstable conditions of the ground at the point where the excavation for the tank was made, the design of the tank was made unusually heavy as shown in the diagram.

To insure watertightness each construction joint was provided with a groove that later was filled with asphalt or clay and the outer surface was covered with a layer of felt and asphalt. Upon completion the interior of the tank received a carefully troweled surface As far as possible the construction joints were placed at such intervals as to provide for expansion and contraction.

In order to keep weather conditions from affecting the tests a steel frame building with brick-filled walls was built over the entire length of the two tanks.

Steam Railroad Tracks in Paved Streets at Philadelphia

A NEW design of track for steam railroad lines in paved streets, adopted by the Department of Public Works at Philadelphia, Pa., has as its main features a 159-lb. 9-in. grooved girder rail and separate rail blocks instead of the usual cross ties, the gage of track being maintained by tie rods. About 5¾ miles of this new track construction have been laid to carry slow-moving freight traffic. The rail is shown in Fig. 1 and the track construction in Fig. 2.

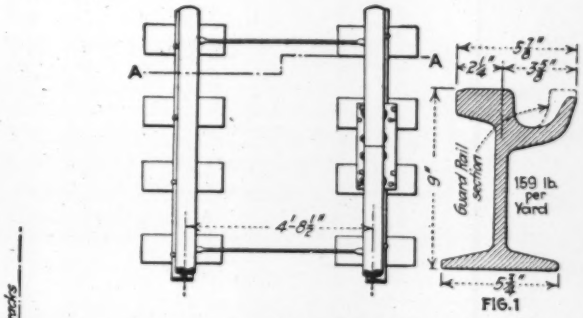


FIG. 1—GROOVED RAIL FOR STEAM RAILROAD TRACKS IN STREETS

FIG. 2—TRACK CONSTRUCTION IN PAVED STREETS

A 9-in. 143-lb. T-girder rail with flat head was used formerly for freight tracks in paved streets, but a more rigid section and a grooved head were considered desirable to stand the wear and traffic and also to permit of laying the paving close to the rail, thus affording a better surface for street vehicles. The form of groove adopted is such that the rail gives a good bearing for the wheels of such vehicles and facilitates their movement in turning out of the track.

A concrete base is used for the entire track area of main tracks and industrial connections, and it is found that the use of separate rail blocks or supports reduces repairs to the granite paving in the track area to a minimum. These blocks, which are of treated wood, are 7 x 9 in. in section and 24 in. long. The foundation is of 1:3:6 concrete and over the base of the rail is a filling of 1:4:8 concrete carrying the 1-in. cushion course of cement and sand upon which the granite blocks are laid. Grout filler is used for the paving and cement mortar is packed against the web of the rails.

Items in Cost of Pumping Water for Irrigation Use

Vital Operating Factors Necessary to Consider in Deciding on Construction Best Adapted for Securing Water Supply

By Barry Dibble

Project Manager, U. S. Reclamation Service, American Falls, Idaho

LOOKING forward to the future of irrigation development in the West it is apparent that the acreage which depends on pumps is sure to increase. Cheap gravity water supplies have all been used and other methods must be applied. Often pumps can properly be considered an alternative to long gravity canals, tunnels or other expensive features. Both from construction and operation standpoints they frequently can be proved the most economical and the most reliable solution of the problem. Each case involves many special conditions which must be considered from all angles before a decision is made on the construction best adapted for securing the water supply.

In the first place a large pumping plant supplying an extensive tract of land presents very different questions from a small unit which pumps water to a single farm or at most to a few neighboring farms. In this region electric drive or direct water-turbine drive are the only ones that need be considered for larger installations. Feasibility in these days is more a matter of cost than of mechanical limitations. Annual costs include fixed charges, power, supplies and repair parts and labor.

Fixed Charges—Interest will vary with the investment. It is often a large factor in determining feasibility, but the case is no different with a pumping plant than with canals or other parts of an irrigation system. When depreciation allowances are made they are assumed to provide against the day when large replacements will be necessary and to retire machinery that becomes obsolete through advances in the art. Within a few years after a plant is put in operation, replacements of apparatus begin and if the plant is well maintained the expenditures for this purpose largely offset the depreciation.

TABLE I—OPERATION AND MAINTENANCE COSTS PER ACRE IRRIGATED

Year	Pumping Division Minidoka Project	Average All Projects	Year	Pumping Division Minidoka Project	Average All Projects
1915	$1.64	$1.61	1919	$2.63	$2.46
1916	1.71	1.66	1920	2.77	2.95
1917	2.02	2.00	1921	2.52	2.55
1918	2.12	2.34	1922	1.85	2.12

Power—The cost of power is usually very important. In recent years there has been such a growth in irrigation pumping that the valley in the load curves of western power companies has been changed into a summer peak. This means that generating machinery installed to carry the irrigation load is to some extent idle in the winter. The result is that a year's interest on the invested capital must be returned by the revenue secured during the irrigation season. As a consequence, in the future cheap power development must usually go along with pumping projects that involve high lifts. Not infrequently it happens that storage or diversion dams can be used at least for seasonal power and, by serving a double purpose, bring the first cost or investment within reach and greatly reduce the annual cost.

TABLE II. COST OF PUMPING PLANTS OPERATED BY THE U. S. RECLAMATION SERVICE DURING FISCAL YEAR 1921-22

Project	Type of Pumping Unit*	No. of Units	Net Lift, Ft.	Acre-Feet Pumped	Cost of Operation and Maintenance	Cost per Acre-Foot	Cost per Acre-Foot per Foot of Lift
Grand Valley, Colo.	V. T. D. C.	1	31	6,635	$1,202.66	$0.18	$0.0058
Huntley, Mont.	V. T. D. C.	2	45	10,200	2,992.91	0.29	0.0065
	G. E. D. C.	2	45	1,870	2,901.71	1.55	0.0345
Minidoka, Idaho	V. M. D. C.	5	29.2	186,283	20,720.90	0.21	0.0072
	V. M. D. C.	4	30.2	153,805			
	V. M. D. C.	3	29.9	92,923			
	V. M. D. C.	2	19.8	12,951			
	Scoop wheel	1	3.5	2,950			
	Scoop wheel	1	2.5	2,601			
	H. M. D. C.	1	7	432	7,825.65	0.27	0.0182
	H. M. D. C.	1	4	2,258			
	Scoop wheel	1	4.8	1,087			
	H. M. D. C.	2	21.2	6,604			
North Dakota	S. T. D. C.	2	56	1,004	7,238.10	7.21	0.1286
	H. M. D. C.	2	26.6	958	6,303.75	6.58	0.2474
	H. M. D. C.	3	12-32	2,386	12,724.52	5.34	0.2427
	H. M. D. C.	1	25-27	628	3,908.71	6.22	0.2392
North Platte, Neb.	V. M. D. C.	1	41	1,235	5,000.00	5.41	0.1353
	V. M. D. C.	1	30				
	V. M. D. C.	1	49				
Okanogan, Wash.	G. E. D. C.	1	55	370	3,292.84	8.89	0.1617
	M. D. C.	1	55	78	268.52	3.45	0.0986
	V. M. D. C.	2	av. 35	1,372	14,716.05	10.73	0.0571
	H. M. D. C.	2	188	808	5,611.16	5.41	0.5410
	G. E. D. C.	1	av. 10				
Salt River, Ariz.	10 V. M. D. C.	11	av. 33.6	17,451	8,180.70	0.47	0.0140
	1 H. M. D. C.						
	H. M. D. C.	4	47	33,927	14,294.10	0.42	0.0089
	V. M. D. C.	16	20.7	13,472	6,334.85	0.47	0.0227
	V. M. D. C.	14	54.6	12,041	18,416.01	1.53	0.0280
	V. M. D. C.	21	av. 29.6	12,727	4,840.53	0.38	0.0128
	H. M. D. C.	1	30	293	543.13	1.85	0.0617
	V. M. D. C.	21	av. 28.4	25,138	11,897.87	0.47	0.0165
	V. T. D. C.	1	103	400	300.00	0.75	0.0073
	H. T. D. C.	1	50	...	200.00	.....	.....
	V. T. D. C.	2	110	16,429	3,769.01	0.2294	0.0021
	H. T. D. C.	1	105	3,304	1,117.82	0.3383	0.0032
	V. T. D. C.	2	200	6,511.6	1,940.00	0.297	0.0015
	H. T. D. C.	1	90	3,672	1,351.63	0.368	0.0041
Yuma, Ariz.	G. E. D. C.	2	5.6	2,000	2,753.28	1.38	0.2460
	G. E. D. C.	2	av. 10	31,969	14,737.23	0.46	0.0460
	G. E. D. C.	1	7	102.5	618.19	6.03	0.8614

* Type V. M. D. C. — Vertical motor-driven centrifugal pump.
H. M. D. C. — Horizontal motor-driven centrifugal pump.
S. T. D. C. — Steam-turbine-driven centrifugal pump.
V. T. D. C. — Vertical hydraulic-turbine-driven centrifugal pump.
H. T. D. C. — Horizontal hydraulic-turbine-driven centrifugal pump.
G. E. D. C. — Gas-engine-driven centrifugal pump.
G. E. D. S. — Gas-engine-driven screw pump.

Good efficiencies can do much to keep down the power input to the pumping plant. There is little difficulty in obtaining electrical apparatus of a high standard. A great improvement has been made in recent years in the efficiency of pumps for both high and low lifts, but a high pump efficiency must be combined with a characteristic (or head-capacity curve) suited to local conditions.

Supplies and Repair Parts—While supplies and repair parts are usually a relatively small percentage of the annual cost they can by no means be disregarded. High efficiency means less wear and tear on working parts and hence results in a reduction of this item. Adequate supervision and frequent inspection can effect considerable saving and improve reliability.

Labor—The number of employees needed both for ordinary operation and for repairs can be controlled in large part by the selection of the machinery and by its arrangement. This factor is too often given scant consideration until the operating man comes on the ground, but if it is evaluated by capitalizing labor savings its importance will be better appreciated. If one large plant serves the project, then one man on a shift represents only a modest outlay (and there is little excuse for designing a plant to require more than one operator), but to keep constant attendance at small and scattered plants requires a large expenditure. In the latter case automatic devices to start, stop and protect the plant are well worth consideration.

That pumping does not necessarily cause increased cost is well illustrated on the Minidoka Project of the U. S. Reclamation Service where water is lifted to an average height of 70 ft. to irrigate 49,000 acres, of which 46,000 acres are actually irrigated. The topography made it necessary to build three stations, each lifting the water 30 ft. All the water (800 sec.-ft.) is pumped by the first station, 650 sec.-ft. by the second, and 430 sec.-ft. by the third. The highest canal is 90 ft. above the first intake. Over the period of years since 1915 the cost per acre irrigated under this system has not varied greatly from the average cost per acre on all the projects of the Reclamation Service (which cover over 1,000,000 acres), as Table I indicates.

These costs are for operation and maintenance only and do not include interest or depreciation allowances. Both columns are on the same basis. As the Minidoka system has been operated since 1909, replacements are now an annual necessity and are included in maintenance costs. In 1921 the cost chargeable to power generation and transmission and to pumping was 80c. per acre; in 1922 it was 69 cents.

It is impossible to fix any physical limit to the height at which irrigation pumping becomes prohibitive. The limit is determined by the cost—the annual cost as compared with the returns from the crops produced. If favorable conditions make for low costs or high yields the height pumped can be much higher than where the opposite conditions prevail.

About 150 pumping plants costing $2,360,000 are operated for irrigation and drainage on the various projects of the U. S. Reclamation Service, lifting water against heads of from 2½ to 200 ft. In the various stations motive power is installed from 5- up to 2,760-hp. capacity. The combined requirements of the stations are 17,500 hp., and the annual consumption of the stations driven with electricity is more than 33,000,000 kw.-hr. An interesting compilation of the operating costs of these stations is given in Table II. Results of operation of pumping plants vary widely, but it is convenient to use a common unit, and for this reason, the final column in the table shows the cost of raising an acre-foot (325,829 gal.) of water 1 ft. high.

Subgrade Results in the Pittsburg Road Tests

Extract from the report of highway research at Pittsburg, Calif., by Lloyd Aldrich, engineer in charge, and John B. Leonard, assistant engineer.

METHODS of constructing subgrade on adobe soil so reduced the objectionable features of this material that a reliable foundation for pavement resulted. This subgrade was not injured by water which filled the side ditches for three months. Rock ballast was less efficient than the earth subgrade.

The site of the test highway was a field in which the soil was a very obstinate black adobe. The ground sloped gently from the south to the north and to avoid variations of subgrade condition the entire subgrade was on fill. On the south side excavation was carried to 3 ft. inside borrow pits and the material was placed loosely outside; the fill for the entire track was then started approximately 3 ft. below finished subgrade elevation. The bottom soil was first plowed about 8 in. to produce a bond and layers of earth approximately 9 in. in thickness, loose, were successively placed from the borrow across the entire width of the roadway, and each layer was pulverized by using a disk harrow followed by a straight-tooth harrow and a Johnson scarifier. After pulverization was complete, a light spray of water was applied over each entire layer sufficient to moisten but not excessively wet the soil, and to aid in compacting it into a dense homogeneous mass. A 12-ton, 3-wheel road roller rolled each layer, and weak spots in the subgrade layers that developed were excavated, and refilled, and rolling continued. The compacted layers were approximately 6 in. thick and each was scarified with a Johnson scarifier for 2 in. to furnish a complete bond with the succeeding layer.

On this approximately completed subgrade, header boards were set true to line and grade and extending slightly below the surface. Then the material between was scarified to a depth of 6 in. by a Johnson scarifier. The surface was then graded with a Carr subgrade machine to an elevation approximately 1½ in. above subgrade. The surplus earth was temporarily placed on the shoulders. Then the subgrade was scarified to a 4-in. depth and water applied with a very light spray, after which the subgrade was immediately rolled from the edges inward. While still moist it was again cut with the subgrade machine to the correct elevation. Up to the time of laying concrete the subgrade was given a light sprinkling daily to prevent cracks forming. Where inverted curbs were involved in the design, excavations were made with pick and shovel.

The sub-base for Section A was especially prepared. After preparation of the subgrade as for all sections, sufficient soil was removed to provide for a layer of crushed rock 12 in. deep on the longitudinal center line, tapering to a thickness of 4 in. at the edges of the pavement and extending out 2 ft. onto the shoulders. The rock was placed in two layers and rolled, the bottom layer consisting of 1½-in. to 2½-in. rock and the top layer ¾-in. to 1¼-in. rock. After rolling and filling the depressions with small rock to bring the surface within 1 in. of the finished subgrade elevation, a layer of earth about 1½ in. thick was placed over the rock and rolled to final compression. The proper subgrade elevation was obtained in the usual way by cutting off a layer of earth with the Carr subgrade machine. The object of placing the soil on the rock was to provide a smooth surface upon which to deposit the concrete and not in any sense to be used as a binder. Rock fill drains were constructed to the borrow pits on each side of the pavement.

Results of Some Researches in Concrete

Abstracts of Papers Presented to the Annual Meeting of the American Society for Testing Materials—Accelerators for Concrete; Fatigue of Mortar, Curing Agents, Workability Tests, and the Behavior of Slag Aggregate

Effect of Accelerators on Concrete

DURING the past two years a sub-committee of Committee C-9 has conducted a co-operative series of tests on accelerators of the calcium chloride type. For some reason, or perhaps several reasons, tests of accelerators do not always give as uniform results as other kinds of tests, and the general conclusions of the report should not be assumed to hold for every possible combination of accelerators and concrete materials. On the other hand, it seems safe to assume that an accelerator which adds to the concrete mixture 2 or 3 per cent (by weight of the cement) of calcium chloride will in the very great majority of cases markedly increase the rate of early hardening.

The tests show that 2 to 4 per cent additions to 1: 2½ mortars increase 2-day strength from 40 to 70 per cent, 7 day from 15 to 32 per cent, 28 day from 1 to 18 per cent and 3 months and one year from 2 to 10 per cent.

The individual results show a very wide range and numerous inconsistencies. However, the averages of all the results seem to establish the general conclusion that the beneficial effects of the accelerators are confined to the early age under the prescribed laboratory conditions of curing and storage. Under these conditions the effect of the calcum chloride is to accelerate the hydration of the cement markedly during the first few days, but the resulting gain in strength largely disappears at the 28-day period and thereafter. The relative strengths of the mortars containing the accelerators after the 28-day period are slightly higher than those of the concretes and of the plain mortars for the later periods.

The marked differences in the results reported from the different laboratories indicate that different brands of cement respond in different degree to the accelerators but the inconsistencies in the results are sufficiently numerous to warn against drawing any positive conclusions in this respect. While the action of calcium chloride on cement is not well understood, it is to be presumed that it is effective in promoting the hydration of one or more of the main constituents of the cement, and as these constituents are known to exist in different proportions in different cements, and even in different lots of the same brand of cement, it should be anticipated that different brands or lots would respond in different degree to the action of accelerators.

In regard to the comparative effects of different accelerators, the data obtained in this investigation suggest that the acceleration of hardening is probably dependent either upon the proportion of calcium chloride to the cement, or the concentration of calcium chloride in the gaging liquid. A considerable amount of time was therefore given to an analysis of the complete data from three of the co-operating laboratories, in which the relative strengths were plotted against the two factors: ratio of anhydrous chloride to cement, and concentration of anhydrous chloride in the gaging water. Curves of the same type were obtained in both cases but the wide range of individual results made it impossible to determine to which of these two factors the relative strengths were more closely related. It would undoubtedly be of interest to know more than we do at the present time regarding the relation of quantity or strength of calcium chloride to the acceleration of the hardening of concrete, and in fact to know more about the action of calcium chloride on cement, but this information must come from a more comprehensive and carefully planned investigation. So far as the data from these tests can be interpreted, the different accelerators produce effects which are mainly dependent upon their calcium chloride content. It is not to be inferred, however, that the acceleration of hardening is directly proportional to quantity or concentration of calcium chloride, for a maximum effect upon the strength of concrete exists on the average not much beyond the maximum concentrations employed in these tests.

In conclusion, the sub-committee would recommend that if further data were to be sought on the effects of accelerators, perhaps the information of greatest practical value would be forthcoming from their effects upon mortar or concrete at temperatures in the neighborhood of the freezing point, and also under conditions where wet curing is impracticable. Results indicate that calcium chloride is more effective under dry curing than under moist curing. It is important also that definite knowledge be obtained regarding the effect of accelerators upon the steel in reinforced concrete. Such meager information as is available at the present time indicates that when steel is completely embedded in dense concrete, the danger of serious corrosion from the chloride is negligible, but it is doubtful whether this statement applies to all types of reinforced-concrete construction under all conditions of exposure.

* * *

Fatigue of Mortar

BY R. B. CREPPS
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THIS PAPER describes in more detail the series of tests already outlined by Prof. W. K. Hatt in *Engineering News-Record*. Concrete beams are tested in reverse loaded as cantilevers mounted on a rigid column. The specimens were 1:2 mortars in 4x4-in. sections 30 in. long.

There is a progressive deformation in the extreme fibers until failure of the test specimen takes place. A straight line of constant slope relation is indicated up to 110,000 reversals of stress. At this point, four cracks appeared on the outermost fibers of the specimen, and the slope of the line changed. An additional 35,000 reversals of stress were necessary to produce complete failure. The critical point in the progressive deformation cycle is designated as the premature failure limit.

Rupture or failure of the bond occurs first on the extreme outer fibers where the deformation is a maximum. This action is progressive toward the center of the beam until complete failure is imminent. Continual progressive deformation of the outer fibers is significant of the fatigue element. Progressive deformation may occur in some cases for a certain number of reversals when it becomes evident from the flatness of the deformation curve that the material is showing no ill effects from repetitions of the load. The assumption is made that loads producing constant deformation are below the endurance limit or the safe working stress of the material.

Recovery Phenomenon — An interesting feature of the fatigue tests is that of the appreciable recovery during a period of rest of the strength of mortar undergoing a fatiguing action. It has been necessary each night to stop the machine and, as a result, the strength recovery phenomenon is clearly illustrated. A parallel action is common to many materials, such as, metals, wood, and soils when they are stressed beyond a safe limit. The amount of recovery in the case of cement mortar is directly proportional to the duration of the period of rest. It is to be noted that no recovery occurs after the premature failure limit has been attained.

During this series of tests it became necessary to stop the machine for five weeks, and as a result the effect of a prolonged rest period is clearly evident from the trend of the deformation curves. The degree of deformation following the rest period indicates that the beam had fully recovered from the initial overstressings. As these beams were five

months old, it is thought that the increase in strength due to age over the rest period exerted a minor influence upon the subsequent resistance of the mortar.

This phenomenon seems to indicate that the rate or number of intermittent applications of load ranging in intensity above the endurance limit would have considerable bearing upon the life of a concrete structure.

Summary—The purpose of the paper has not been to present finished data or to draw definite conclusions concerning the fatigue of mortar and concrete, but more to stimulate interest and discussion of the subject. There are, however, several indications of prominence which are emphasized by this investigation:

1. (*a*) 28 Day Tests, 12 Beams, 1:2 Mix.—Results of this series of tests indicate that no definite endurance limit between 40 and 60 per cent of that load required to break the beam under a single application can be assigned to cement mortar of this age.

(*b*) 4 Month Tests, 8 Beams, 1:2 Mix.—Results of this series of tests indicate that the endurance limit is approximately 50 to 55 per cent of the static load.

(*c*) 6 Month Tests, 6 Beams, 1:2 Mix.—Results of these tests indicate that the endurance limit is 54 to 55 per cent of the static breaking load.

2. The number of reversals of stress necessary to cause failure decreases in a proportion to the respective increase of the percentage of stress above the apparent endurance limit.

3. Stresses above the endurance limit cause continual progressive deformation.

4. Stresses below the endurance limit may cause progressive deformation within certain limits.

(In either 3 or 4, progressive deformation is not significant of permanent injury to the product unless actual rupture of the bond occurs on the extreme outermost fibers.)

5. The effect of a rest period indicates that the rate and number of intermittent applications of load ranging in intensity above the endurance limit would have considerable bearing upon the life of a concrete structure.

6. (*a*) The amount of recovery in strength in the case of cement mortar is directly proportional to the duration of the period of rest.

(*b*) Above the premature failure limit no appreciable recovery occurs.

* * *

Calcium Chloride as a Curing Agent and Accelerator

By H. F. Clemmer and Fred Burggraf
Engineer of Materials, and Assistant Engineer of Materials, Illinois Division of Highways

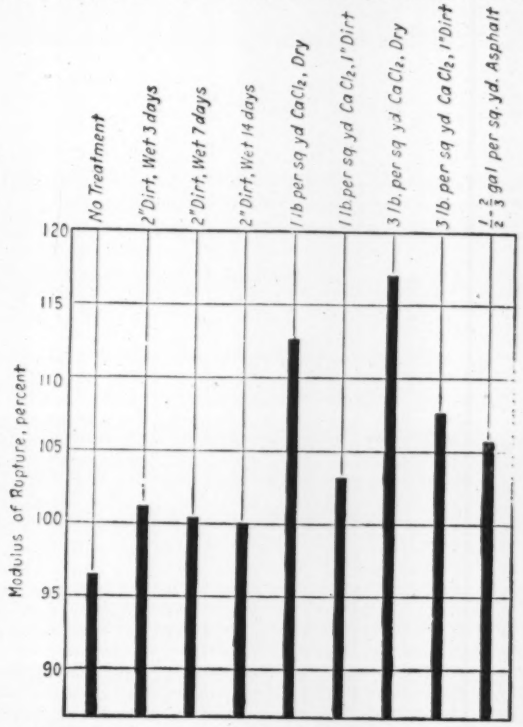
THIS PAPER reviews the investigations in the use of calcium chloride both as a curing agent and as an eccelerator in the setting of concrete, conducted by the Illinois Division of Highways, the results of which have led to the adoption of both the external and internal usage of calcium chloride in concrete highway construction.

External Treatment—Over 500 concrete slabs, 8 x 12 x 30 in., were subjected to various surface treatments and tested for transverse strength. Cylinders, 6 x 12 in., were also made to serve as a check on the compressive strength of the concrete making up the transverse specimens. The same volumetric mix of 1:2:3½, which is the standard adopted by the state of Illinois for concrete highways, was used in all specimens. Portland cement was used in all cases and the aggregates consisted of sand and washed limestone which passed all state specifications.

As Illinois was interested primarily in securing a satisfactory curing at the end of 28 days or earlier, more emphasis was placed on these short-time tests than on 60- or 90-day specimens. For the purpose of checking the strength of the untreated specimens at the older ages, a number of 60- and 90-day specimens were made. At the time of testing, the specimens were removed from their forms and broken in a universal testing machine with the treated side in tension. The modulus of rupture was then computed and the variation in strengths considered as a measure of the completeness of curing.

[Three series are reported, of which the first is typical.]

The accompanying diagram contains a graphical comparison of the results of the various curing methods as indicated by the moduli of rupture of the specimens in Series 1, the results shown being the average of 11 specimens. As the curing of concrete with 2 in. of dirt wet for 14 days has been considered by this state a satisfactory method of curing, the specimens cured under this method have been regarded as 100 per cent cured and the results obtained by other methods taken as a percentage of this.



COMPARISONS OF EXTERNAL TREATMENT OF CONCRETE WITH CALCIUM CHLORIDE
Strength of Specimens Cured with 2 in. Dirt, Wet 14 Days, Taken as 100 Per Cent Cured. Each Result Is the Average of 11 Specimens. Age 28 Days.

As shown in the figure, only those specimens which received no treatment showed a strength less than 100 per cent, while the specimens cured with 3 lb. per sq.yd. of calcium chloride indicate the maximum of 116.9 per cent curing. Those slabs cured with 1 lb. per sq.yd. of calcium chloride also show a high degree of curing.

The early strength obtained with using calcium chloride curing would indicate that a pavement could be opened for traffic at the end of 14 days, whereas under the old method of curing it was felt unsafe to subject a pavement to traffic in any less time than 30 days. The results obtained from the specimens which were treated with calcium chloride that was removed some hours later illustrate that at the end of 28 days, proper curing has taken place. In other words, if the calcium chloride remains on the concrete for a period of 24 hours, its removal will not affect the curing of the concrete. Later tests in this regard illustrate that even less time than 24 hours was required for calcium chloride to properly cure concrete.

A brown surface stain developed on the specimens cured with magnesium calcium chloride. This discoloration of the concrete seems to result from the use of magnesium calcium chloride and for this reason this material as a curing agent is eliminated.

It is evident in the comparison of results on the speci-

mens cured in like manner, but having both a normal and oiled subgrade, that no benefit is derived from the oiled subgrade. In both the 14- and 28-day tests, less strength resulted from the specimens placed on the oiled subgrade than was obtained with the normal condition of subgrade.

A study was also made of the effects of concentrated and excessive amounts of calcium chloride on the surface of mortar briquettes. The proper distribution of this material is a constant source of trouble with the highway department and it was thought advisable to learn as far as possible in the laboratory the effects of too much calcium chloride on the surface of concrete. Consequently, a number of briquettes were made and were subjected to surface applications of calcium chloride up to what would amount to 10 lb. per sq.yd. of surface. A puffing up of the surface was noticed with the result that a deadened concrete was developed. The danger of a like condition developing in a pavement surface is seen when, in cases where moisture is present in the calcium chloride drums, the salt has a tendency to lump into pieces of considerable size. When these pieces are larger than the size of an egg, their use should not be allowed until they are broken up, since injurious effects of uneven application of the salt will result.

Though the exact action which takes place in the concrete when a surface application of calcium chloride is applied is not known, a theory has been advanced which appears to be the most logical of any yet advanced. The great amount of work done with calcium chloride by the Illinois highway department corroborates so far as is known the theory which is as follows:

The hygroscopic properties of calcium chloride are responsible almost entirely for the value of the material as a curing agent. Though the calcium chloride may not obtain sufficient moisture from the air to satisfy this property, its presence on the surface of a concrete specimen which contains more moisture than the air, attracts moisture to aid in the dissolution. This action of the moisture being drawn to the surface of the specimen leaves minute channels, which, after the complete dissolution of the chemical, affords passages for the calcium chloride solution to penetrate the surface, thus giving it access to more cement particles and causing more complete hydration in a shorter time. This quick hydration and decomposition of the lime compounds of the cement particles on the surface causes an impervious layer which prevents drying of the concrete.

An understanding as to the reason for approximately as great a strength resulting in 14 days from the use of calcium chloride as that resulting in 28 days when curing with wet dirt is apparent when the two methods of curing are considered. In curing with wetted dirt, the increase in strength and hardness of the concrete is due to the ever present moisture which gradually hydrates and decomposes more of the lime compounds. In curing with calcium chloride, the chemical acts as an accelerator in hastening the hydration and inter-reaction of the cement particles on and immediately below the surface.

Rules for Application of $CaCl_2$—As a direct result of the investigation in curing concrete, the Illinois highway department is now permitting the use of calcium chloride in curing state highways. In order to reduce the cost of curing by this method, the amount used has been specified as 2½ lb. per sq.yd. of surface, this amount being considered as effective as the 3 lb. which was employed in the tests. In order to acquaint the engineers and contractors with the use of the material, a circular has been issued which reads:

"Calcium chloride may be used in connection with curing of pavements, taking the place of the usual curing with earth and water, or the curing with water by what is known as the "ponding method." Two and one-half pounds of the flaked or granular material (the flaked is preferred as it is more easily distributed and less easily removed by wind or rain) shall be applied to each square yard of pavement and it shall be distributed uniformly over the surface of the finished pavement by means of a mechanical drilling device or by the use of shovels and long-handled brooms. The material shall not be spread upon the pavement until the latter has thoroughly set—ordinarily from six to eight hours time after the particular pavement has been laid.

"Calcium chloride shall not be applied during rains and experiments have definitely determined that if a rain follows the placing of the calcium chloride after a period of two or three hours there will have been enough absorption of the calcium chloride by the new pavement preceding the rain so that there will not be required additional applications of the material.

"Although the water line for curing of pavements with water may be omitted where central mixing plants are operated and calcium chloride is used in curing; nevertheless the general specifications with regard to wetting of subgrade and the general specifications with regard to placing of burlap on the freshly deposited concrete and the wetting of burlap shall be strictly enforced. The use of calcium chloride for wetting the subgrade will not be permitted. When calcium chloride is used in curing, the sides of the concrete pavement shall be banked with earth as soon as the forms are removed."

Internal Treatments—The investigations in internal treatment with calcium chloride was mainly in reference to the effect on setting time, the strength in low temperatures, the internal temperatures, and the variable strengths obtained with the same percentage of material in different brands of standard cements. Some work was begun on determining the percentage of hydration caused by the calcium chloride but sufficient data are not at hand for a comprehensive discussion of the experiment at this time, although a short outline of the work will be given. Both physical and chemical tests were included in this investigation. A uniform incorporation of calcium chloride was obtained by dissolving the chemical in the gaging water before the water was placed in the mixer.

It was observed that the setting time of the specimens at both temperatures is reduced through the addition of calcium chloride. The specimens containing 3 per cent by weight of calcium chloride indicate the best results as far as securing the quickest set is concerned.

The investigations conducted with concrete specimens poured in low temperatures merely illustrated the fact that even the presence of a large percentage of calcium chloride will not allow the placing of concrete in freezing temperatures without some provision being made to protect the concrete from the cold weather. Probably the most striking feature of this experiment was the failure of the specimens to gain strength past the 14-day period.

Considerable time was spent on the study of the variation of internal temperatures caused by the incorporation of the different amounts of calcium chloride. It was found that a greater heat is generated by the specimens containing the larger percentage of calcium chloride.

It has been fairly well established that various brands of standard cements hydrate four to five times as fast as others when incorporated with a constant solution of calcium chloride.

Rules for Inclusion of $CaCl_2$—The results secured in these investigations were such that the Illinois Division of Highways was satisfied that calcium chloride could be incorporated in concrete to advantage under certain conditions. Consequently, its usage is allowed in cold weather construction upon the permission of the engineer in charge of the job. To insure the proper supervision, the department has issued a circular explaining how this material must be used. The circular reads as follows:

"The department will permit the use of calcium chloride in the concrete mix for pavement construction during cold weather. When used, the solid, granulated, flaked, or powdered materials shall be thoroughly dissolved in water. It is recommended that the proper amount of calcium chloride solution should enter the mixer drum just before the water is added to mix the aggregates, or the solution may be added direct to the stone or sand when in the skip.

"When used in the pavement work, not more than two per cent by weight of the cement shall be used.

"Calcium chloride should not be used in a pavement that crosses an electric railroad, but its use should be discontinued approximately one quarter of a mile from the elec-

tric railroad crossing. There is no objection to using the material when the highway parallels an electric line. Calcium chloride shall not be used *in pavements which are reinforced.*

"It is not definitely known at what temperature concrete will freeze when the two per cent of calcium chloride is mixed with the concrete and it will, therefore, be necessary to arrange to cover the pavement with loose straw or earth as soon as it has taken sufficient set to prevent marring of the surface. In other words, calcium chloride hastens the setting of the concrete but is in no sense a protective. It makes possible an earlier application of a straw or earth covering.

"Due to its action on reinforcing steel, calcium chloride shall not be used in bridge or culvert construction; therefore, the usual precautions should be taken when placing concrete in culverts and bridges during temperatures around freezing point.

"All material should be purchased with the guarantee that it contains from 70 to 75 per cent calcium chloride and before using samples should be submitted to the testing laboratory, as in the case of any other materials."

* * *

A New Test for the Workability of Concrete

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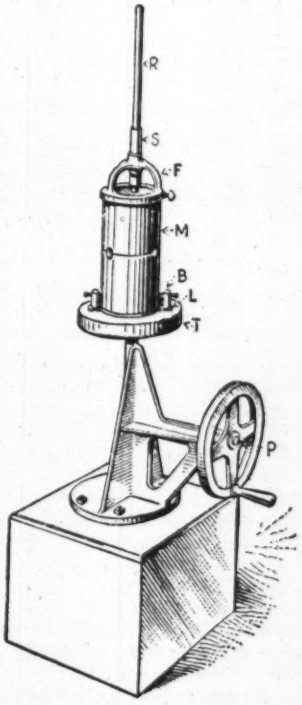
IT IS NOT easy to define the terms "workability," "plasticity," "consistency," etc., as applied to concrete mixtures. Some authorities use these terms more or less synonymously; others prefer to distinguish between workability and consistency, considering the latter as a property directly related to water content and measureable by the slump, flow, and other tests, whereas workability is regarded as more intrinsically a characteristic of a given mixture, dependent not only on the water content, but essentially upon the other ingredients of the mixture. We incline to this latter view, and without attempting to give an exact definition of workability, we consider one concrete mixture more workable than another when the process of mixing, handling and placing are accomplished with less effort in the one case than in the other. The direct quantitative measurement of this effort, for example, in placing a concrete mixture in any sort of a form or mold is a very difficult thing, chiefly because there is no telling when one arrives at a definite condition that may be taken as a stopping point in the placing operation. We have made many attempts to measure the workability of various concrete mixtures in this way, but thus far without success.



During the past two or three years we have given a great deal of thought to the possibilities of measuring the workability of concrete by some indirect method and eventually came to the penetration test which is the subject of this paper.

Apparatus—The apparatus used in the penetration test is shown in the drawing. *M* is a 6 x 12-in. pipe mold with a watertight bottom, fitted with slotted lugs, *L*, by means of which the mold is fastened to the small drop table *T*. The latter is in reality an ordinary flow table with a special top carrying two clamp nuts, *B*, which engage the lugs, *L*, of the pipe mold. The table top can be raised and dropped through a height of ½ in. by means of a cam on the end of the shaft *P*. Fitting the top of the pipe mold closely is a detachable brass spider *F* carrying a fixed sleeve *S*, which, when the frame is in position on top of the mold, is exactly in alignment with the axis of the mold. The sleeve *S* is ⅜ in. inside diameter and 6 in. long. A steel rod, *R*, ⅜ in. diameter, 20 in. long, weighing 1100 g. completes the apparatus. The lower end of the rod *R* is hemispherical, and the upper portion is graduated in 0.1 in. in such manner as to read directly the depth of the lower end below the top of the mold when inserted in the sleeve *S*.

Method of Test—The mold *M* with the brass spider *F* clamped to the top is fastened to the table by means of the clamp nuts. The batch of concrete to be tested is scooped into *M* until the latter is filled to the brim. No attempt is made to puddle the concrete into the mold, but a rod is used to spread the concrete uniformly as it falls from the scoop. After the mold is filled, the table top is raised and dropped a given number of times to subject the concrete to a definite amount of compacting force. Our practice throughout has been to give the concrete thirty ½-in. drops. At the completion of the preliminary jolting or settling, the rod *R* is inserted in the sleeve *S* and lowered gently into the concrete until it comes to rest under its own weight. The table is then raised and dropped, and from the force of the impact the rod penetrates a certain distance into the concrete, indicated by the reading of the scale. The impacts are repeated and the successive penetrations of the rod are noted until the latter has reached nearly to the bottom of the mold. In practically all of our tests the penetration has been carried to a depth of 11 in.

It is quite obvious that different mixtures should show different resistances to the penetration of the rod, the more plastic mixtures allowing the rod to penetrate readily, the harsher mixes offering high resistance. The property that we were admittedly trying to measure was the tendency of a mixture to pack under a definite amount of settling or compacting. This we seemed to have accomplished, judging from the results of a considerable number of preliminary experiments, but a more complete interpretation was lacking. It was primarily to furnish an interpretation of this test that the present investigation was undertaken; incidentally the investigation was so planned as to contribute some interesting information regarding the effects of certain powdered admixtures.

Conclusions — The penetration test described in this paper is the first worthwhile solution of the problem of measuring the workability of concrete which the authors have found in a research extending over a period of several years. As used in this investigation, the test is lacking in desirable precision; it furnishes a measurement of workability in arbitrary units only, and it is not applicable to the entire range of concrete mixtures. On the other hand, these faults can probably be eliminated, and even in its present stage of development, its indications seem correct and in accord with the best judgment of a number of experienced operators. This is true if workability is defined as that property of a concrete mixture upon which depends the amount of work required to handle and place the concrete *uniformly*, under the ordinary conditions of use.

As indicated by the penetration test, the workability of a concrete mixture seems to depend upon two factors, segregation and lubrication. It appears that both of these factors can be controlled by a suitable selection of ingredients, an increasingly fine aggregate reducing the segregation, and powdered admixtures reducing segregation and promoting lubrication. This increase in workability brought about by the use of finely divided admixtures seems to be proportional to the fineness as measured by the completeness or extent of dispersion of the material in the mixture. Thus, celite was found to have greater effect in improving the workability of concrete mixtures than kaolin, and kaolin a greater effect than hydrated lime.

In studying the relation between workability and consistency, as indicated by the penetration and flow tests,

respectively, the interesting conclusion was reached that workability depends more on the character and proportions of the solid ingredients in the concrete than on the amount of mixing water used. Although this conclusion may appear open to question, the authors believe it to be correct, and they also believe that false notions in regard to workability of concrete have been created by reference to chuting operations. The facility with which concrete flows down a chute is probably dependent both upon workability *and water*, the effect of the latter predominating in the over-wet mixes. Whatever the facts may be, the indications of the penetration test substantiate the authors' opinion that there is no premium upon, and rarely an excuse for, employing a consistency higher than that giving the maximum workability obtained in these tests.

Under damp storage conditions, small quantities of admixtures generally increase the strength of lean mixtures, even though they require an increase in the amount of mixing water for a given consistency. The richer mixtures under the same conditions suffer a slight loss in strength. It is important, however, that further work be done to establish the effects of admixtures under drying conditions, where it is quite probable that strength, as well as workability, will be benefited. It is important also that further work on the subject include studies of the relative yield and shrinkage of concretes with and without admixtures, since these factors must be taken into account in determining the resultant effect in the finished product.

* * *

Blast-Furnace Slag as an Aggregate in Concrete

By Raymond Harsch
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THE U. S. Bureau of Public Roads started an extensive investigation in the summer of 1919 to obtain information relative to blast-furnace slag as an aggregate in concrete. This investigation consisted in obtaining plant data from the field inspection of about thirty crushing and screening plants which were at that time producing slag in commercial sizes.

In these tests, everything was held constant except the coarse aggregate. This varied from the very porous, honeycombed material produced by some plants to the black, glassy slags of others. The consistency of the mix was kept constant throughout the entire investigation. A slump of 1 in., corresponding to a flow of 160, was used. All results shown in the table are averages of tests on 3 to 5 specimens made and tested on different days and are the results of the compression and wear tests outlined above. These are represented by the part of the table down to and including limestone from Plant L. The tests on slag from Plants A, B, and C were made to determine the effect of maximum size of coarse aggregate.

Comparing the results of compression tests on concrete containing coarse aggregate from Plants Nos. 1 to 30 with those containing gravel and limestone, the highest strength obtained was 3656 lb. per square inch with slag aggregate, and the lowest 2809 using Potomac River gravel. The lowest strength of the slag concrete is 2906, which represents a high-silica, low-lime slag of glassy texture. The strength of limestone concrete is practically equal to the average strength of the slag concrete. The results of the wear tests show a lower percentage of wear for slag concrete than for either gravel or limestone. The differences, however, are small in most instances, and the test does not warrant any specific conclusion other than the fact that the slag concrete is as satisfactory as gravel or limestone concrete when tested by the Talbot-Jones rattler.

The lower part of the table contains results of tests on slag, gravel, and limestone concrete, when the variable was the maximum size of the coarse aggregate used. Group A refers to ¼- to 2-in. aggregate, B is ¼ to 1 in., and C from ¼ to 1½ in., all being proportioned between the sieves in amounts necessary to give a straight-line grading. The results seem to indicate that the ¼- to 1-in. slag and limestone make the strongest concrete, while the reverse is true for the gravel used. The slag shows a strength equal to that of limestone and superior to the gravel in every case.

As in the preceding results, less wear was found for the slag concrete than for the concrete containing either gravel or limestone. The wear tests results show the strongest slag concrete to have a greater loss in wear that the weaker concrete. The ¼- to 1-in. slag concrete (the strongest slag concrete), however, still shows less loss than either the gravel or limestone concrete of any sizes of aggregate.

Wear Investigation—An investigation of the suitability of many doubtful aggregates has been in progress for some time, consisting of circular track wear tests. The results of tests on the control specimens, made in connection with this investigation, throw some additional light on the relative value of slag as an aggregate in concretes. At the time the test sections of this experimental pavement were placed, three compression cylinders, three Talbot-Jones wear blocks and two 6 by 8 by 48-in. plain concrete beams were molded for each type of surface.

These results bear out the conclusions derived from the other investigations. They show slag concrete to be superior to the gravel concrete and also to the limestone concrete used in these compression and transverse-bending tests. Slag concrete wear blocks showed a lower percentage of wear than either the limestone or gravel except in the case of Section 1.

Attention is directed to the result of tests of a blast-furnace slag which had been hand picked from the lightest commercial slag available. In selecting this material, only the honey-combed pieces were included. The unit weight was only 56 lb. per cu.ft. when the material was uniformly graded from ¼ to 1½ in. This represents the type of slag which is the cause of most of the unfavorable comment regarding its use as an aggregate in the wearing surface of concrete pavements. An analysis of the test results on this material shows that the strength and wearing quality is not greatly impaired by the lightness or porous nature of the aggregate.

TABLE SHOWING RESULTS OF COMPRESSION AND WEAR TESTS OF SLAG AGGREGATE CONCRETE.

Mix: 1:2:3
Cylinders: 6 by 12 in.
Blocks: 8 by 8 by 5 in.
Age: 28 days
Average of 3 to 5 specimens

Plant	Aggregate	Compression Test: Average Strength, Lb. per Sq.In.	Compression Test: Weight per Cubic Foot, Lb.	Talbot-Jones Test: Wear, Per Cent	Talbot-Jones Test: Weight per Cubic Foot, Lb.
No. 1	Slag—river sand	3,359	139	11.2	139
No. 2	Slag—river sand	3,316	138	10.1	139
No. 3	Slag—river sand	3,510	140	9.2	138
No. 4	Slag—river sand	3,219	144	8.6	146
No. 8	Slag—rivtr sand	3,353	136	10.1	136
No. 9	Slag—river sand	3,223	136	8.5	137
No. 10	Slag—river sand	3,159	141	10.3	142
No. 13	Slag—river sand	3,422	139	7.0	140
No. 15	Slag—river sand	3,547	142	9.5	141
No. 16	Slag—river sand	3,565	142	9.8	141
No. 17	Slag—river sand	3,265	141	8.3	140
No. 21	Slag—river sand	3,069	138	9.2	136
No. 23	Slag—river sand	3,051	132	10.8	135
No. 25	Slag—river sand	2,936	143	8.7	143
No. 26	Slag—river sand	3,064	140	8.9	144
No. 27	Slag—river sand	3,231	141	9.2	145
No. 28	Slag—river sand	3,656	141	9.3	142
No. 29	Slag—river sand	3,409	137	9.3	141
No. 30	Slag—river sand	2,906	140	11.1	140
G	Gravel—river sand	2,809	146	11.6	147
L	Limestone—river sand	3,301	152	11.8	150
A	Slag, ¼ to 2 in.	2,979	140	9.4	138
B	Slag, ¼ to 1 in.	3,345	142	10.1	138
C	Slag, ¼ to 1½ in.	2,914	138	9.6	137
G-A	Gravel, ¼ to 2 in.	2,648	147	10.6	147
G-B	Gravel, ¼ to 1 in.	2,455	146	11.5	145
G-C	Gravel, ¼ to 1½ in.	2,733	147	10.8	146
L-A	Limestone, ¼ to 2 in.	2,791	133	11.2	148
L-B	Limestone, ¼ to 1 in.	3,001	154	13.8	149
L-C	Limestone, ¼ to 1½ in.	2,931	150	12.6	151
P	Slag—Potomac River sand	2,462	134	13.1	140
S	Slag—slag sand	2,029	127	13.7	127
G	Slag—granulated slag	1,670	121	14.7	121

Summary—The data presented do not indicate any new development in the knowledge about slag used in concrete. They merely represent the work of unbiased operators endeavoring to find the value of slag as compared to two other concrete aggregates, limestone and gravel.

Specimens have been made for testing at the age of one, two and five years. A series of corrosion tests have been planned to determine the relative corrosive effect of slag, gravel and limestone aggregates upon reinforcing steel.

The following general conclusions are interpreted from the data resulting from this investigation:

1. The unit weight of blast-furnace slag as produced commercially has little if any effect upon the structural strength or the wearing property of the resulting concrete.

2. A limit of 70 lb. per cubic foot would admit practically every well-graded crushed slag product.

3. The gravel used in these tests is one of accepted quality and is considered to be of average strength. The limestone used for comparison with the slag is somewhat superior to the average limestone used for concrete. The strength of all of the slag concretes exceeded that of the gravel concrete. The average strength of the slag concretes is equal to the strength of the limestone concrete.

4. Because of the excessive chipping at the edges of the wear blocks, the wear test is not considered a very favorable indication of the resistance of concrete to wear. It is a means of comparing the value of various types of concrete subjected to the action of the shot, and is interpreted as such by the author. On this assumption, the wear-resisting properties of slag concrete are equivalent to those of the limestone concrete and superior to those of gravel concrete tested in comparison.

5. The physical properties of the slag when tested by the usual rock tests do not seem to be an important factor in determining the quality of the concrete made with slag as the coarse aggregate.

Possibilities in Engineering Society Co-operation

President of American Society of Civil Engineers Outlines His Views As To Methods of Getting Together

From the Presidential Address of C. F. Loweth, President, American Society of Civil Engineers, at the Annual Convention, Chicago, July 11, 1923.

MUCH HAS BEEN said of late of co-operation of engineering societies as though it was something new. It is not new. There has always been a goodly degree of co-operation; however, the great increase in the number of such societies and the fact that many of them are so highly specialized has seemed to call for an increased co-operation and at the same time made it increasingly difficult to bring about.

The membership requirements of some societies stress most strongly technical qualifications; in fact, in some the technical qualifications are highly specialized, and are fully met by manufacturers and expert technicians. In others the outstanding qualifications for membership are those of professional attainments and in some of these professional attainments of a highly specialized nature; in still others, social or local affiliations are a large factor in membership qualifications. It must be obvious then that under such widely varying society ideals co-operation will necessarily be restricted to matters of common interest. These may be local or national affairs, may be purely technical matters, or be those of a professional character; in each case the incentive for co-operation will vary. The incentive and opportunity for co-operation depends therefore, in a very large degree, upon a common interest, the purposes and ideals of the several groups and equally so upon an approximate equality of ability for the furtherance of that common interest. With such a multiplicity of engineering societies as now exist, co-operative efforts, if unduly forced, will naturally tend to a compromise of essentials or to the over-emphasis of many things of minor importance. In such case the danger would be to the societies of largest prestige and highest ideals.

This society has recently and for the third time, declined to join with certain others in an all-inclusive plan of engineering society co-operative work. There is ample evidence that these decisions have been based upon the plan of and not upon the spirit of co-operation. Clearly this is so, for the whole history of the society shows time and time again a deeply rooted disposition to co-operate fully and freely whenever there has been opportunity to do so effectively. At the present time there is a very large degree of co-operation amongst engineering organizations in technical matters. The extensive and very excellent work being done by the Engineering Standards Committee, which is sponsored by a number of the engineering societies and participated in by many of their members, is a co-operative effort of high order; the same is equally true of the excellent work of the Division of Engineering of the National Research Council. Much other technical activity is being fostered through the joint agencies of various engineering societies. It makes but little difference whether this is accomplished through temporary agencies, such as joint committees, or more permanent ones. The American Society for Testing Materials and the American Railway Engineering Association may be considered, in view of the fact that many of their members are also members of other less specialized societies as co-operative organizations by engineers. Effective co-operation calls for united effort and, equally at other times, requires that one party shall refrain from duplicating the activities of the other. The setting up of Engineering Foundation for the furtherance of research in engineering and of United Engineering Societies for the management of the joint property interests of the four large national societies, called by these acts the Founder Societies, are other notable instances of co-operation.

In other than technical matters co-operation has not progressed as far, although far from being negligible. In those matters pertaining to the services of the engineering profession to the country and those pertaining to the general welfare of the profession, there is room at this time for more concerted activity on the part of engineering organizations. Considering these in their broadest aspects, it would seem as if it was the especial obligation, and as well the privilege, of the large national societies, particularly those in which the professional qualifications for membership are the highest and which for these reasons have the prestige and wealth of personnel, leadership and funds beyond those of local or specialized societies, to undertake primarily and largely the burden of representing the engineering profession at large. In that case then the Founders Societies with other national organizations of approximately similar standing and character might profitably set up some agency through which they might co-operate as occasion requires.

Such an agency might well meet the following requirements: Its field of activity should be specific. It should have definite responsibility to its sponsors, yet with some freedom of initiation and action. It should be elastic enough to meet varying needs, to act promptly in emergencies, to enlist such aids as might be helpful. Its vision should be nation-wide and its organization such that the influences initiating its action should be no less broad. Its chief function should be largely to bring about concerted action of various organizations as their mutuality of interest and influence might make necessary, rather than to attempt to speak for them, and it should so function as to leave room for expression of minority opinion or qualified approval where unanimity could not be obtained except as a result of compromise. It should have no incentive to be active solely for the sake of activity. The dangers of a super-organization should be thoroughly guarded against by tying it closely to its sponsors, and it may well be that its organization could be composed of men serving automatically by virtue of their offices in the sponsoring societies.

Such an agency, by whatever name it may be called, in addition to be being useful in co-operative efforts, would doubtless promote the welfare of each sponsoring society.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Reinforced-Concrete Patch on Pipe Elbow Withstands Heavy Wear

IN PLACING the concrete lining in a small tunnel around one end of Priest Dam, on the Hetch Hetchy project in California, it was most convenient to deliver the concrete by the pneumatic method through a 6-in. pipe. The pipe, however, had to pass down a vertical 50-ft. shaft and at the bottom make an abrupt 90-deg. turn to enter the tunnel. Under this condition the air pressure of 100 lb. per square inch used for delivery,

BEND IN 6-IN. PIPE REINFORCED WITH CONCRETE
This bend had given more than seven times the average life of unreinforced pipe and was still in service when the job was finished.

plus the effect of gravity, caused excessive wear on the sharp bend in the bottom of the shaft. In fact the wear was so great that standard pipe bent to make the 90-deg. turn within a length of about 8 ft. sometimes had to be renewed after eight hours of service and seldom lasted more than three shifts.

To overcome this excessive wear a special bend was made up with an 8-ft. length of pipe bent into a right-angle turn, as usual, but reinforced by a concrete block or patch cast around it for the purpose of continuing to withstand the wear after the pipe itself had worn through. The concrete was 6 in. thick, entirely encircled the pipe, and was reinforced with 1¼-in. drill steel bent to parallel the curve of the pipe. This steel was wired together and placed in the form with the pipe before the concrete was poured. The total weight of the 8-ft. pipe elbow and the patch which was cast around it was about 800 lb.

The special bend made in this way, and shown in the accompanying photograph, served continuously for the remaining 21 shifts required to complete the job. When the pipe line was dismantled, inspection of the special elbow showed that the wear had gone through the pipe and also entirely through the 1¼-in. drill steel but had not yet worn through the surrounding concrete.

The tunnel lining work was done under the direction of W. F. Webb, president of the Universal Concrete Gun Co.

Suspended Structure Carries Sanitary Sewer Over Stream

BY J. C. KEELEY
Paducah, Kentucky

IN PLANNING the $1,300,000 sewer program in Paducah, Kentucky, half of which is now under construction, it became necessary, in order to serve certain territory, to cross a stream, known as Island Creek, with a small sanitary sewer, the point of crossing being about 500 ft. upstream from its junction with the Tennessee River.

Due to long periods of high backwater from this river, during which an inverted siphon would be submerged to a depth of 30 ft., it was decided to effect a crossing with an overhead structure, rather than an inverted siphon, as flow through the latter would be seriously retarded and cleaning rendered difficult; the danger of destruction to the overhead, or suspended, structure by floods in the creek is considered slight, owing to the small watershed of the creek and its large channel so near the Tennessee River. The floods in the creek do not reach the height of the sewer except when the river is high; and, at such time, the current is diffused and reduced because of its expanse over a wider channel. The danger due to ice is also slight, as ice of sufficient thickness to endanger the structure does not form in this section. No serious flow of drift need be expected.

The crossing was built of 18-in. cast-iron pipe—in 12-ft. lengths, weighing 110 lb. per foot—carried on reinforced piers on the approach and over the channel suspended by steel members swung from the floor over the existing concrete arch bridge.

Piers of reinforced concrete to carry the approaches were built on 12-ft. centers, the upper portion being shaped to fit the lower half of the pipe.

Five structural steel hangers were used to suspend the sewer over the main creek channel. Each hanger was built of two 6-in. x 6-in. x ⅜-in. angles, riveted back to back and bolted to the under side of the bridge floor with three 1-in. bolts; lateral braces to the hanger, made of 6-in. x 4-in. x ⅜-in. angles bolted to the hanger near the bottom and to a 3-in. x 6-in. angle clamped around the arch ring, served to stiffen the structure and to provide additional support. Holes for the 1-in. bolts were drilled through the bridge floor from the roadway with an air drill; and a cable, lowered through one of the holes and operated by a derrick on the roadway above, hoisted the hangers into place, the hangers having been previously floated into position on a scow. The lateral braces were erected by means of a scaffold mounted on the scow.

After all the hangers were in place, the 15-in., 33-lb. channel was floated into position on the scow, raised and bolted to the hangers. The pipe was then floated on the scow into position, raised and suspended by bolts to the hangers and to the channel. The individual pipes, however, were not drawn fully into position until

HANGERS, BOLTED TO BRIDGE FLOOR, CARRY SEWER

all the pipes were assembled; after which the joints were calked with lead wool. After the calking was completed, the sewer line was drawn into final position by taking up on the nuts on the U-bolts.

The work above described is a part of the $620,000 sewer construction now being done by the city of Paducah, Ky., the E. R. Harding Co. of Racine, Wis., being the contractor. Design and engineering supervision is being done through the office of the Department of Public Works of Paducah, of which Henry A. Pulliam is commissioner and chief engineer.

Cost of Cleaning Ballast by Machine and Hand; Pennsylvania R.R.

A WORK-TRAIN outfit used for cleaning stone ballast on the Western Pennsylvania division of the Pennsylvania R.R. consists of a locomotive, a flat car with 20-ton ditcher or revolving crane handling a grab bucket, a gondola car with a fixed inclined screen, and cabooses for the train crew and cleaning gang. A ballast cleaning train is shown in Fig. 1, but the train is sometimes made up with two or three ditchers and screens.

For the one-unit train, a gang of twenty laborers with a foreman works ahead of the train to remove the ballast between the ties, piling it in the center ditch to be picked up by the bucket, which also excavates the ballast outside of the track. With the train there are the operator and fireman on the ditcher, two laborers, the locomotive engineman and fireman, the conductor and a brakeman, making about twenty-nine men.

A ¾-, ⅞- or 1-yd. grab bucket is used, according to the distance between track centers. It is fitted with teeth to tear up the compacted ballast to a depth of about 20 in. below base of rail. The quantity of ballast averages 1.07 cu.yd. per yard of single track. No new material is added when the cleaned ballast is put back.

A woven screen may be used, of ¼-in. rods spaced 1½ in. c. to c., or a ¼-in. plate screen punched with holes 1¼ in. square and ½ in. apart, the holes in alternate rows being staggered. As shown in Fig. 2, the screen frame is 9 ft. wide and 11½ ft. high, with its lower end pivoted to a horizontal base frame which rests upon the sides of the car and has a hinged support or back leg to support the screen in its inclined position. This base frame is clamped to the car.

The screen itself tapers from full width at top to 27 in. at the bottom, each side being formed by a 3x3-in. angle and 12-in. upstanding plate riveted upon the frame. At the bottom is a steel hood delivering the cleaned stone to an inclined chute which is hung along the side of the car (see Fig. 1) and deposits the stone just outside the ties, ready to be thrown back into place with forks. The dirt which falls through the screen goes into the car and the screen is shifted along as the car fills.

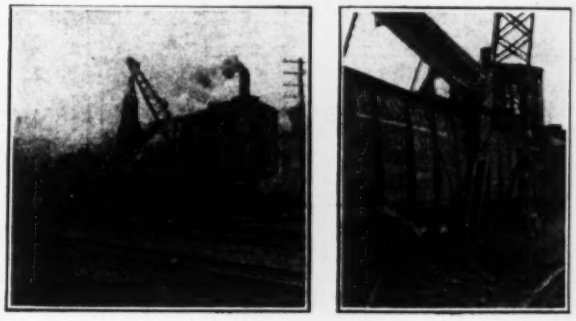


FIG. 1—BALLAST CLEANING TRAIN
At left, train with ditcher and screen. At right, bucket picking up old ballast and chute delivering cleaned stone from screen to track.

The ballast train on one track handles the ballast of the adjacent track and must keep clear of regular trains. Extra trains get orders to look out for the ballast train. A portable telephone outfit enables the conductor to keep informed as to train movements and thus avoid unnecessary delays in getting clear of trains which are late. As a rule a two- or three-mile stretch of line between interlocking plants is given up to the ballast train. The actual working time averages from three to five hours per day, except where special arrangements are made for exclusive use of the track. In length of track cleaned per day, the maximum record is 3,455 ft. with one ditcher in 6 hr. 50 min. working time, the dirt screened filling five gondola cars. Other records include 1,320 ft. for one unit, 2,100 ft. for two units and 3,000 ft. for three units in one train.

Cost of Ballast Cleaning—In the comparison of cost of cleaning by machine and by hand, the cost is based on length of center ditch cleaned, as in both cases hand labor is employed for removing the ballast from cribs or between the ties and piling it in the center ditch. But the cost of machine work includes the screening of this extra ballast, while that of hand work is for the ballast in center ditch only. The figures in the accompanying table are for three ditchers and screens in one train and for an 8-hour day.

In a test for cost of cleaning ballast by hand, the men were required to clean to the same depth that is cleaned by the machine, 10 to 12 in. below the bottom

COST OF CLEANING BALLAST BY MACHINE: P. R. R.

Train Service		
Engine service, including oil, fuel, etc...	9½ hr. @ $4.59	$44.75
1 Engineman	9½ hr. @ 0.86 ($1.29)*	9.14
1 Fireman	9½ hr. @ 0.63 (0.945)*	6.69
1 Conductor	9½ hr. @ 0.725 (1.0875)*	7.16
2 Brakemen, each	9½ hr. @ 0.56 (0.84)*	11.06
		$78.80
Ditcher expense for three-ditcher unit.		
1 Ditcher foreman	8 hr. @ $0.628 per hr.	$5.02
3 Ditcher enginemen, each	8½ hr. @ 0.567 per hr.	4.82
3 Ditcher firemen, each	8½ hr. @ 0.506 per hr.	12.90
9 Ditcher laborers, each	8 hr. @ 0.37 per hr.	26.64
Cost of repairs, fuel, oil, etc., each	8½ hr. @ 1.00 per hr.	25.50
Depreciation	8½ hr. @ 0.75 per hr.	19.12
	Three-unit ditcher expense.	$94.00
	Train service	78.80
Total cost to clean 3,000 lin.ft.		$172.80
or cost per linear foot		0.0576

* Pay 1½ time after eight hours.

of the ties, and to dispose of the dirt over the bank about 20 ft. away. The labor used was exceptionally good and the men worked hard with the knowledge that the job had a special significance. The average per man was 26 ft. of center ditch (9-hour day). Cost per linear foot, 14.6c., as compared with 5.76c. for the machine work.

It is pointed out that in making comparisons the fact should be kept in mind that the machine cleaning is not affected by rain, extreme heat and other weather conditions that affect the efficiency of labor. Another decided advantage in machine cleaning is that the long digging teeth of the bucket tear up the "cleaning floor"

From Job and Office

Hints that Cut Cost and Time

slope to prevent the erosion of the ditch itself from caving the bank. Where the drainage area is not large we simply specify that one furrow shall be plowed from 4 to 10 ft. back of the slope stakes, turning the furrow toward the cut. It is not always necessary to clean out this ditch by hand, but it is essential to have the course of the furrow run in such a direction as to maintain as

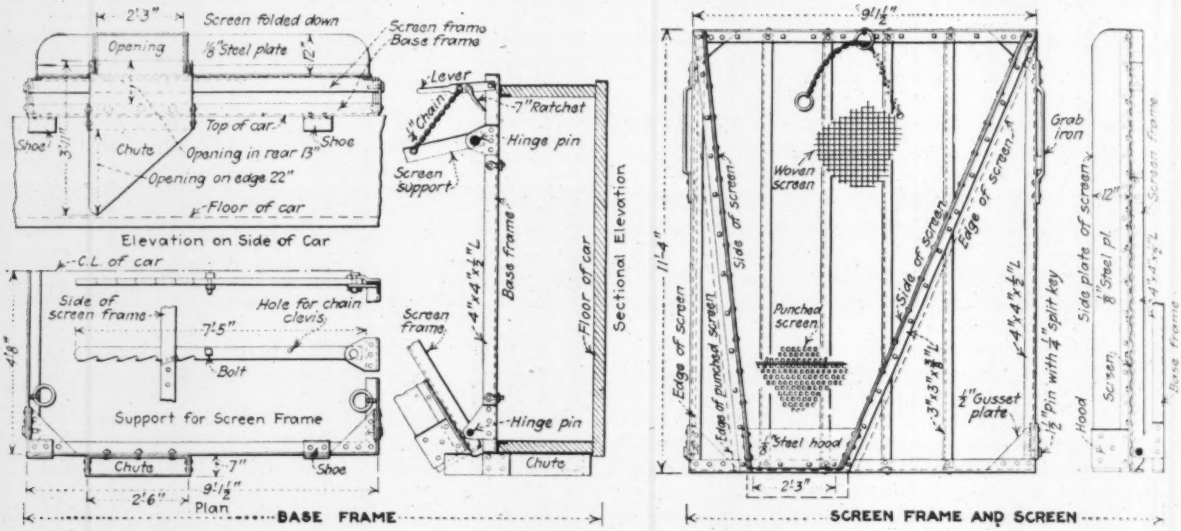


FIG. 2—FOLDING SCREEN FOR CLEANING BALLAST

at least 6 or 7 in. below the depth actually cleaned. The term "cleaning floor" is given to the bottom of the compacted mass of dirt and ballast that the trackmen shovel and fork over. This floor is gradually built up by successive cleaning and is objectionable in that it holds water and prevents it from draining away. This method of handling the cleaning of ballast on a busy main line was planned under the direction of Robert Faries, division engineer, Pennsylvania R.R., Pittsburgh, Pa.

Importance of Intercepting Ditches on Highway Construction

By F. M. Balsley
Engineer-Inspector, Wisconsin Highway Commission

IN THE planning of road projects it is believed that not enough attention is paid to the necessity of installing intercepting ditches above the top of the back slopes in cuts and outside the toe of slopes where the ground slopes toward the fill. This is particularly true in side-hill construction where there is a considerable drainage area above the road. Practically all highway specifications call for a neat and smoothly trimmed back slope in the cuts. In order to preserve this neat appearance it is essential that all water from the area above the top of the cut be prevented from running down the face of these slopes.

The simplest means of preventing erosion is an intercepting ditch placed far enough from the top of the near as possible an even grade all the way down the hillside. Where the slope is fairly even the ditch may be close to parallel to the top of the cut, but in rough ground, of course, this is not true.

This intercepting ditch should be cut immediately after the slope stakes are set, then the work is protected while it is under construction. In cases where farm fences interfere and it is necessary to cut the intercepting ditch inside the fence line, it has been found that it is fairly easy to convince the property owner that the ditch will be a protection to his property rather than a damage. If the erosion of the slopes is not headed off, eventually the banks will cave in and the fence will go with them.

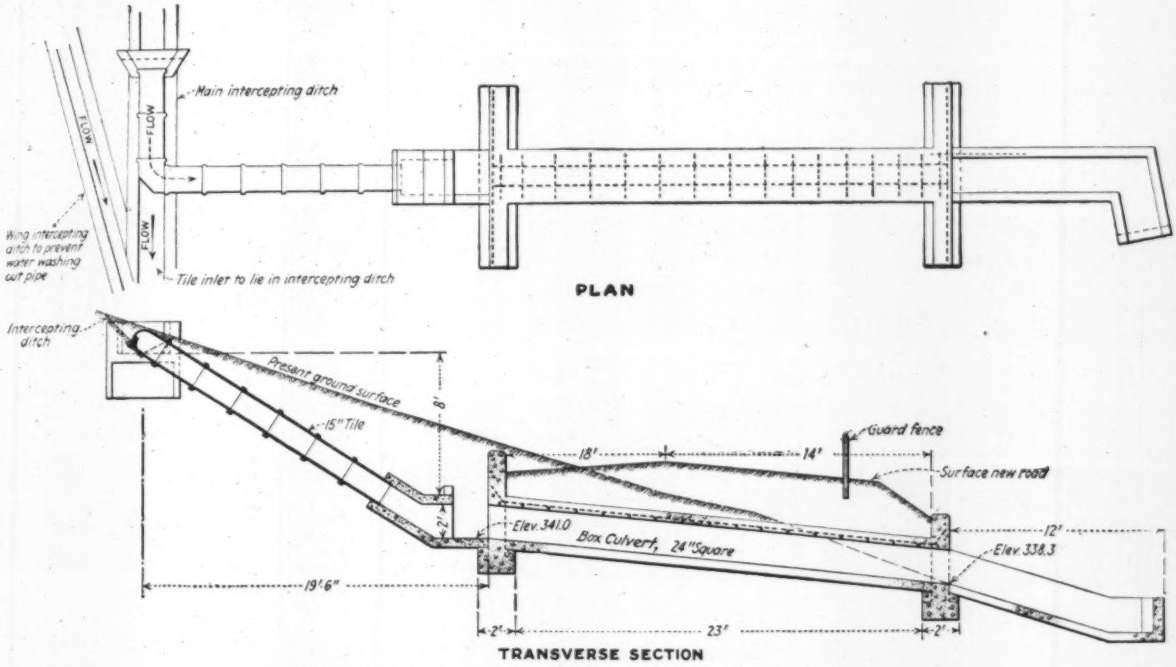
Where fills are made on sloping ground it is essential that an intercepting ditch be cut beyond the toe of the slope to protect the fresh fill from being washed out by the first flood. Many of our contractors and county commissioners fail to protect their work in cases of this kind. One furrow at the right point will form a ditch that will protect the toe of the slope and prevent material from washing out.

The plan shows a special type of culvert and downspout that was designed to take care of the water from the intercepting ditch on Project 41 in Grant County, Wisconsin. In this case there was a large drainage area above the road and the slope of the hillside was extremely steep. The ditch was first plowed and the loosened material was removed with a slip scraper. The culverts were placed in such a position that it was pos-

From Job and Office

For Contractor and Engineer

sible to drain the intercepting ditch directly into the culverts, thereby relieving the road ditch from a large amount of water. The grade on the finished road is 7 per cent, and it can readily be seen that if the accumulated water from the side hill, were carried in the road ditch it would be impossible to maintain the road at anything



WING AND INTERCEPTING DITCH PROTECT ROAD SLOPE

like a reasonable cost because of the greater erosion that would take place.

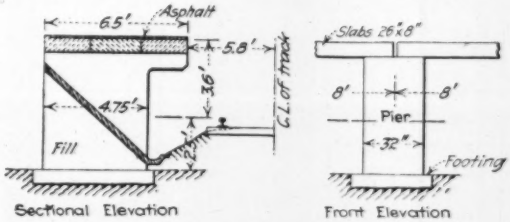
The wing ditch shown in the accompanying plan runs to a point back of the inlet to the downspout and heads off water that would otherwise follow the downspout and wash out the fill that covers it. A recent visit to this project indicates that this installation will never cause any trouble and it has been giving excellent service for the last three years.

In making a survey in rough country the notes should indicate the points where an intercepting ditch will be required and information relative to the size of a ditch necessary to carry the water. The typical sections for the finished work should also show the installation of an intercepting ditch in the cut as well as the fill section. If the ditch is large bids can be asked for on a cubic-yard basis. Where a plowed ditch is sufficiently large bids should be asked for at so much per linear foot of ditch. In the state of Wisconsin, where we must maintain roads after they are constructed, the matter of protecting the work as it progresses is of the utmost importance. In spite of this fact, many of our engineers fail to realize that a cheap, easily constructed intercepting ditch will save many times its cost in maintenance thereafter.

Concrete Units for Station Platforms

HIGH platforms to replace low ones were required in the electrification of the suburban lines of the Buenos Aires Western Ry. at Buenos Aires, Argentina, and it was necessary that this work be done without interrupting traffic or inconveniencing passengers. To meet these conditions a type of reinforced-concrete unit construction was adopted, so that the units could be placed during the night, the platforms consisting of piers with cantilever tops carrying deck slabs, as shown in the accompanying drawing.

The piers, about 32 in. thick, are spaced 8 ft. c. to c. and have a cantilever projection of 1 ft. 9 in. on the track side, thus affording a refuge for workmen; this arrangement also permits persons who might fall from the platform to roll clear of the track. Between the piers there is a solid fill having the track side sloped



UNIT CONSTRUCTION FOR HIGH PLATFORMS

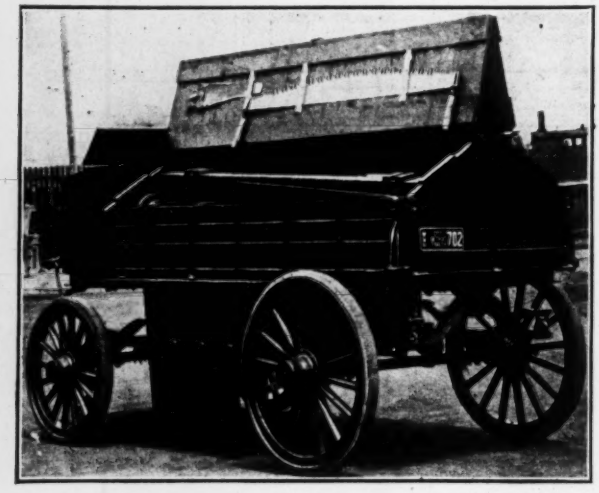
and faced with concrete which ends in a drain or gutter. The slabs are 8x2.2 ft., with a thickness of 8 to 9 in. and are covered with a layer of asphalt.

In carrying out the work, portions of the low platform were removed to allow of placing the shallow footing for the piers, the openings being covered before the next day's traffic began. The next night a work train with a supply of units was run to the station and

a 5-ton steam locomotive crane set the piers on the footings and then placed the slabs. In this way about 330 ft. of platform could be built in two nights, including the erection of temporary wooden handrails, steps and ramps. The finishing work was then done by day and night shifts. At the terminal station a temporary high platform for the suburban tracks was built on one of the low platforms by placing timber bents which were framed in advance and handled by the crane.

Truck Trailer Carrying Tools for Water-Works Emergencies

FOR serious emergencies the Detroit Water Department has a truck trailer with tool boxes filled with everything likely to be needed. The truck has rubber



TRAILER WITH FIVE BOXES FILLED WITH EMERGENCY TOOLS

This outfit is always packed and ready to be taken to serious pipe breaks, large fires or other emergencies requiring quick action.

tires and good springs, which permits it to be pulled at any speed the hauling truck can make without disarranging the contents.

The following named articles, listed alphabetically for ease in finding, are included in the five sections:

EMERGENCY TOOL LIST, DETROIT WATER-WORKS

Article	Section	Article	Section
1 Axe	3	6 Pails, galvanized	2
1 Axe, hand	3	12 Picks, concrete	3
6 Bars, concrete	2	6 Picks, dirt	3
3 Bars, steel, ¾-in., 7 ft. long	2	2 Pc. Pipe brace, 1½-in., 3 ft. long	3
3 Bars, steel, tunnel, 5 ft. long	3	50 Points, large diamond	4
2 Books, gate	1	2 Pots, lead pouring	4
6 Pr. Boots, rubber	5	40-Ft. Rope, 1-in.	4
1 Broom, heavy	3	1 Ruler, 6 ft. long	1
6 Cutters, asphalt	3	1 Saw, cross-cut	3
50 Cutters, handle	4	1 Saw, hand	3
3 Hammers, calking	4	2 Scrapers, ice	3
4 Handles, concrete pick	3	2 Shovels, concrete	3
4 Handles, dirt pick	3	2 Shovels, iron, snow	3
4 Handles, sledge	3	3 Shovels, short handles	3
10 Handles, sledge	2	18 Shovels, long handles	3
24 Handles, tool	4	6 Sledges, heavy	2
2 Hooks with rope 12 ft. long	3	3 Sledges, light, 6-lb.	2
4 Hooks, lead pot	4	6 Sticks, pipe	2
4 Hooks, timber	2	6 Suits, oil-skin	1
4 Horses, collapsible	2	1 Tape line, 50-ft.	1
1 Key and bar, shut-off	2	2 Tools, calking, large sets	4
1 Key wheel, 8 sticks	2	6 Washers, 3-in. suction hose	4
3 Knives, packing	4	6 Wedges, frost	2
8 Lanterns, red	5	12 Wedges, steel	4
4 Lanterns, white	5	1 Wrench, hose	4
2 Ladders, short	3	1 Wrench, hydrant	4
6 Lifters, lead	4	1 Wrench, monkey, 15-in.	4
1 Light flash	1	1 Wrench, monkey, 12-in.	4
1 Map section	1	1 Wrench, Stilson, 18-in.	4
5 Lb. Nails, 10d	2	1 Wrench, Westcott, 10-in.	4
5 Lb. Nails, 20d	2		
1 Pail and dipper, water	5		

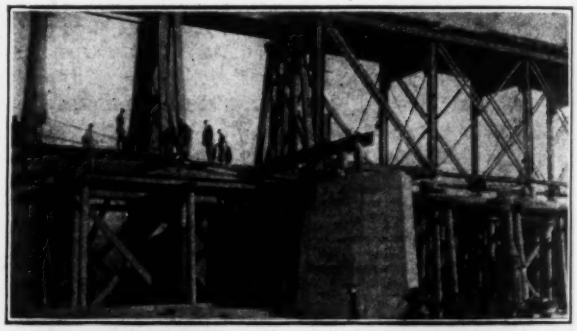
From Job and Office

Hints that Cut Cost and Time

Santa Fe Ry. Moves Six Bridge Spans 43 Ft. Endwise

SHIFTING five bridge spans simultaneously was accomplished by the Atchison, Topeka & Santa Fe Ry. in moving a six-span single-track deck-truss bridge 43 ft. lengthwise, in order to place the structure on new piers. The bridge in question crosses the Des Moines River near Dumas, Mo., and was built originally in 1887, but the superstructure was renewed in 1904. The 150-ft. deck truss spans are in good condition, but the stone masonry was found to be disintegrating badly. It was decided, therefore, to build new double-track piers on the same center line but east of the old piers, at a distance of two panel lengths of the trusses, or 42 ft. 11¼ in., this distance giving the necessary working space to construct the new piers. Solid rock is found about 6 ft. below low-water level and there were no difficulties in the foundation or pier construction. The height from low water to base of rail is about 56 ft.

In order to make the change it was necessary to revamp the east truss span by cutting off one panel at each end, thus shortening this span 42 ft. 11¼ in., after which this span was moved east to its final location, the intervening gap being filled in with falsework (Fig. 1). Between the old and new piers falsework was placed, as shown in Figs. 1 and 2, to carry the rollers for shifting the remaining five spans. The adjoining vertical end posts of the remaining five truss spans were fastened together by means of diaphragms and also securely



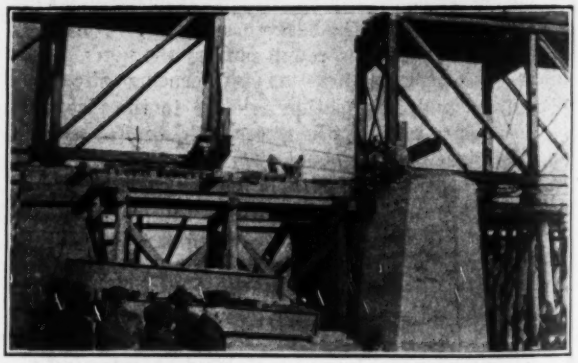


FIG. 1—MOVING TRUSS SPANS ON SANTA FE RY.

At top, west end of east span resting on new pier, with falsework at left closing gap in deck and between new and old piers. At bottom, upper-deck falsework removed and spans moving to right towards new pier.

From Job and Office

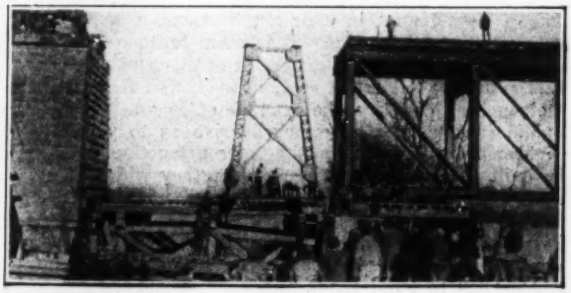
For Contractor and Engineer

tied with steel cables. The spans were jacked up, the shoes removed and a grillage of T-rails was installed, which carried the load directly to the roller nests, as shown in Fig. 2.

Two stationary hoisting engines were installed between the old east abutment and the first new pier, one on each side of the bridge; these operated the 1¼-in. hemp ropes, passing through two 6-sheave blocks which were used in moving the spans. After the spans were moved to the new piers, the gap at the west end was filled in with a 42-ft. deck girder span resting on the old remodeled west abutment and on a steel bent on the new west pier. The placing of the bent on the new pier and of the girder span on abutment and bent is shown in Fig. 3.

FIG. 2—ROLLER NEST UNDER SPANS

Actual moving of the spans occupied a little less than an hour, while traffic was blocked only 5½ hr. The entire work was planned and carried out under the direction of A. F. Robinson, bridge engineer of the Atchison, Topeka & Santa Fe Ry. System. The moving of the steel spans was done by the American Bridge Co., while the Missouri Valley Bridge & Iron Co. built the new substructure and removed the old piers.



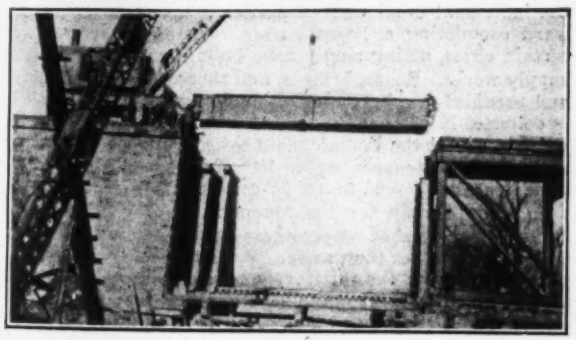


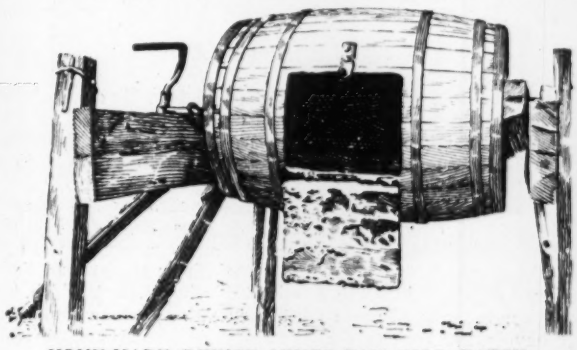
FIG. 3—CLOSING GAP IN BRIDGE

At top, placing new steel bent on new pier carrying west end of last truss. At bottom, placing 42-ft. girder span to rest on abutment and steel bent.

Barrel and Automobile License Plates Form Tar Cold Patch Mixer

By John S. Crandell
Consulting Engineer, The Barrett Co., New York.

A VERY simple form of mixer for making up tar cold patching aggregate is shown in the illustration herewith. It consists of a strong barrel with a door cut in one side and hinged so that it may be securely shut and latched. On the inside three old motor license plates are bolted so as to form blades to assist in churning the mix. The barrel is mounted on strong supports, and a substantial crank is attached to the axle on which the barrel revolves. One man can do the entire work of mixing, and can supply sufficient material to keep a small maintenance gang busy. Or, where there is maintenance patrol by single patrolmen, this simple mixer is all that is required to make up the daily batch.



HOME-MADE DEVICE MIXES TAR COLD PATCH

This mixer has been in operation for a year, and the output has taken care of the needs of one patrol gang's section.

The apparatus illustrated could be improved by making it more substantial. A steel drum might be substituted for the wooden barrel, and a rigid support mounted on wheels so that the mixer might easily be moved from one location to another.

Fender Chains Protect Panama Lock

One of the chain fenders protecting the lock gates at the Gatun locks of the Panama Canal proved its value on May 25 when struck by a steamer. The following account is condensed from the *Panama Canal Record:*

The steamship "Hoven" in tying up at the Gatun locks, on arrival from Gatun Lake, struck the chain fender protecting the upper guard gate. It is estimated that the vessel was going approximately four miles an hour and it was stopped within 50 ft. The chains prevented a collision which might have resulted in serious damage to the vessel and the locks, as the water in the upper chamber was about 15 ft. lower than Gatun Lake. Both chain fender machines apparently worked satisfactorily as about thirty-five links were pulled out from one and forty-two from the other. The incident was caused by a misunderstanding of signals in the engine room. These fender chains are stretched across the lock chamber from near the tops of the walls. To allow a ship to pass, the chains are lowered into a recess in the side walls and lock floor. After the ship passes, they are raised again. The mechanism consists of a hydraulically-operated system of cylinders, so that 1 ft. movement by the cylinder accomplishes 4 ft. by the chain. When a pressure of more than 750 lb. to the square inch is exerted against the fender, the chain is paid out by an automatic release until the vessel stops.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Safe Roadway Widths

Sir—In connection with the discussion on safe roadway widths, a point deserving attention is the tendency of automobile traffic to form a single lane in each direction, regardless of the width. This tendency does not occur in wide city streets; but on suburban and country roads, where the traffic is crowded, the impulse to drive in the middle of one's own half of the road seems to be almost impossible to overcome.

In theory, a suburban road 25 or 30 ft. wide ought to be good on holidays for two lanes of outgoing travel in the morning and for two lanes of homeward travel in the evening. I have never, however, seen this occur.

The principle reason for using a roadway width of more than 20 ft. is to make it easy for faster cars to overtake and pass slower ones. In *Engineering News-Record*, July 12, 1923, p. 74, is a letter by G. F. Schlesinger, urging the undesirability of roadways of 20-ft. width on the ground that they invite a third lane despite their insufficient width. I have never noticed any such tendency, but, on the contrary, I have often noticed the insufficiency of such a width for permitting a faster car to overtake and pass a slower car, especially a truck. To make the roadway so narrow as to force an overtaking car over to the left of the road may be good engineering, but it is exasperating to the driver on a winding road who finds himself compelled, sometimes for miles, to trail a car ahead which is just fast enough so that he cannot safely pass it within the visible distance.

Unless the shoulders are very smooth, drivers on main roads will seldom turn onto them to allow an overtaking car to pass. The writer's conclusion is that a roadway less than 20 ft. wide, and preferably 22, is not safe. This refers to the concrete or bituminized surface. The width over shoulders should be at least 30 ft., and the shoulders should be kept smooth and flush with the main surface.

Where one such road is insufficient for the traffic, two alternative routes are better than one wide road, on account of the tendency to drive in single lanes each way.

HERBERT L. TOWLE,
David Lupton's Sons.

Philadelphia, Pa., July 19, 1923.

The Bar to the Solution of the North Jersey Water-Supply Problem

Sir—The water-supply situation in northern New Jersey, commented on editorially in your issue of July 12, p. 46, suggests comparison of the way public water supplies have been handled in that section and in eastern Massachusetts.

More than 30 years ago, some cities and towns adjacent to Boston were situated, as regards their public water supplies, very much as are now situated the municipalities encircling Newark and Jersey City. For this district in Massachusetts there was created by legislative action a Metropolitan Water Commission of three members appointed by the governor. This board took over the water-supply works of Boston and acquired other water-supply property. It borrowed large sums of money, issuing bonds on the credit of the state as security. It built works ample for the purposes of supplying water to the Metropolitan District. It paid the interest on the money borrowed, and paid off the principal from the money received for the water furnished in wholesale lots, and at wholesale prices, delivered to the several municipalities to be supplied, Boston included. The commission, since merged with like district commissions for main sewerage and for parks, is still at work.

Nothing is simpler in general outline; nothing more effective, or economical. Each municipality attends to the details arising within its own borders, the commission selling water in wholesale quantities, delivered to each municipality, and furnishing the main channels by means of which it is again removed in a sanitary manner.

Why cannot precisely the same plan of operation be engrafted on the life of the municipalities of northern New Jersey? Why has it not long ago been done? Why is there a continuance from year to year of a dearth of ample sanitary public works in northern New Jersey, conceived, constructed, operated and paid for, in a sane manner? The answer may be found in a portion of Art. IV of the New Jersey constitution which reads: "The credit of the state shall not be directly or indirectly loaned in any case." Therefore, instead of having Commissioners *with powers of initiative* to construct and operate for them ample works of public, sanitary necessity, the inhabitants of northern New Jersey are put to it to get such works at all. As population increases, each little municipality becomes unable to properly care for these needs. The works then, and thereafter, needed, must be planned with a vision that extends far into the future, and far beyond the boundaries of any and of all these municipalities, and mayhap into other states than their own. Such planning must continue indefinitely, and the commissioners must have full powers of initiative and of condemnation.

Of what need any "Jerseyman" be afraid should a proposition be presented amending Art. IV to read: "Except for the construction, maintenance and operation of works of water supply and main drainage, to be owned by and operated for the sole benefit of the people, the credit of the state shall not be directly or indirectly loaned."

The existing prohibition was intended, so it is said, to prevent the legislature from extending state aid to works of private enterprise, conducted for private gain, as in the wild days of the Camden & Amboy and other railroad ventures. It should no longer stand in the way of the creation of sanitary works needed for the public good.

How many states of the Union have such a clause, as this of New Jersey, in their constitutions, it would require some study to determine. It is plain that no state should throttle the construction of needed sanitary public works in this manner. All states may, instead, well follow, in their metropolitan districts, the example of Massachusetts, since public sanitary works, comprehensive as to political subdivisions served and as to time of construction, must needs be built in the manner described or they will not be built at all.

This is said with full knowledge of the fact that New Jersey is helping build a monumental bridge to Pennsylvania and a vehicular tunnel to New York; has voted $40,000,000 to build roads and has managed, by invoking the individual credits of some twenty towns, to go far toward completing a Passaic main sewerage scheme, while certain cities, acting singly have built commendable water-supply works. Roads, bridges, and tunnels can be estimated and provided for, by a single, lump-sum appropriation. It is doubtful if any one cognizant of all the facts would ever want to repeat the Passaic main sewerage mode of working under the sustenance of a lot of independent warring municipalities, forced to act as commercial partners.

A water supply for the communities of northern New Jersey is a piece of work whose practical problems must largely be met as they arise. With the constant increase of population on the territory under consideration, it is a work without end. It is the need of the greater part of the population of the whole state. And it should have the support of the legislation of the state, modeled upon the legislation of any state of the Union most favorable for the planning, construction, and operation of works supplying such a need. New Jersey should no longer be prevented by an antiquated clause in the constitution, designed for a wholly different purpose, from adopting the sole rational method for the procuring by the people of what the people must have to live.

CLEMENS HERSCHEL.

New York City, July 16, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Contract for the Construction of a Dam and Power House at Island Portage on the Abitibi River on the power development project of the Hollinger Consolidated Gold Mines, of Porcupine, has been awarded by the company to Sir William Arrol, Ltd., of St. Catharine's, Ont., and London. Plans call for the installation of equipment with a capacity of 25,000 hp.

Orders for 1,000 Freight Cars have been placed by the Canadian National and Canadian Pacific Railways, the cars to have a capacity of 60,000 lbs. and to be much larger than the ordinary freight cars. The orders are distributed among several companies. The Canadian Pacific cars are of various types and are to be built at the Angus shops of the company in Montreal.

Traffic Tests on the Bates Experimental road near Springfield, Ill., conducted for more than a year by the Illinois State Division of Highways were discontinued last week. Approximately 1,000,000 tons of traffic have been imposed on the road and the majority of sections have shown decisive failures. H. F. Clemmer, engineer of materials, suggests that those who care to view the results arrange a visit within a few days as the road will be turned over immediately to the contractor for reconstruction.

Bonds of the Canadian National Railways to the amount of $22,500,000, bearing 5 per cent interest and guaranteed by the Dominion Government, will shortly be issued for the purpose of equipping the railways with the necessary rolling stock. Hon. W. S. Fielding, Canadian finance minister, has announced. The total cost of the equipment required is $3,000,000, one-quarter of which is provided by the general appropriation made by Parliament for railway purposes. Equipment orders given for the railways owned or controlled by the government have since 1918 reached a total of about $130,000,000.

Competitive Examinations of Applicants for cadet engineers to fill vacancies in the Coast Guard will be held in several of the large cities of the country, commencing Sept. 10, 1923. Applicants must be between 18 and 23 years of age at the time of the examination and successful candidates will report about three weeks later at Coast Guard Academy, New London, Conn. Cadet engineers are trained to become engineer officers; during training they receive the same pay and allowances as midshipmen in the navy and upon graduation, after three years at the academy, are commissioned as ensigns. Information as to the places of examination and further details may be obtained from The Commandant, U. S. Coast Guard, Washington, D. C.

St. Paul Votes $5,500,000 Bonds for Water-Works and Sewers

Bonds totaling $5,500,000, of which $2,500,000 are for water works improvements and $3,000,000 for trunk sewers, were authorized at a popular election in St. Paul, Minn., on July 16. At the same time a charter amendment was approved that will for the immediate present increase by $550,000 a year the total amount that may be appropriated by the city for certain purposes. This amendment provides that at least $400,000 of the amount shall be used to pay (1) the city's portion of paving intersections and (2) the cost of paving that portion of streets that are over 24 ft. wide and (3) to apply on the cost of trunk or main sewers.

The chief purpose for which the water-works bonds will be used is for an 8-ft. reinforced-concrete conduit to parallel the present brick conduit, built in 1885 from Vadnais Lake to the city. The estimated cost of the new conduit is $900,000. Other conduits and open channels connecting the Vadnais Lake system are estimated to cost $150,000; new feeder mains to new districts in the city, $600,000, and new distribution mains and meters, $170,000 a year for a period of five years.

The $3,000,000 trunk sewer bonds will provide for what is known as the belt line in the northeast part of the city at an estimated cost of $1,200,000; Trout Brook extension, $700,000; the Maryland-Como system, $400,000, besides seven other projects ranging in cost from $30,000 to $200,000.

U. S. Engineers Order Survey in Los Angeles

Washington Correspondence

A survey of the port development at Los Angeles has been ordered by the Board of Engineers for Rivers and Harbors. This survey, however, is not to include the proposed extension of the break-water so as to shelter Terminal Island. The hope is expressed at the Corps of Engineers that this survey can be co-ordinated closely with that of the municipality. If that can be arranged, much duplication and unnecessary expense can be avoided, it is believed.

The proposal to establish terminal facilities on Terminal Island does not meet with the approval of many of the Government's engineers who have looked over the project. They see no reason for expending $8,000,000 to extend the breakwater especially in view of the experience indicating the inadequacy of breakwater protection against the surges which characterize the Pacific.

In addition to the drawbacks of the physical formation of the Island, it is pointed out that inside terminals would be justified if there were no other argument in their favor than the better accessibility from the land side.

Architects' Bridge Design Again Under Discussion

Three Allegheny River Bridges In Pittsburgh To Be Rebuilt—Engineers Design Declared Unworthy

Controversy over whether important bridges should be designed by architects has again broken out in Pittsburgh, where discussion of the same kind developed four years ago. At that time the county commissioners retained two architectural firms for the design of two of the new Allegheny River bridges, that at 40th St. and that at 16th St., the architects to have full direction of both design and construction. Protests by the American Institute of Consulting Engineers, the Board of Direction of the American Society of Civil Engineers, and the Engineers Society of Western Pennsylvania against this delegation of engineering work to persons not trained in the problems and art involved were of no effect. The present controversy involves the 6th, 7th, and 9th St. bridges, which must be rebuilt under orders of the War Department for more clearance and channel width.

Work Delayed

Work on these three bridges has been delayed by the county officials for a number of years, and appeal made to the War Department to receive its order for the raising of bridges over the Allegheny River issued seven years ago. However, early this year the department reaffirmed its position that the bridges must be raised, and the county is now preparing to proceed with the work.

Preliminary plans for the 7th St. bridge were prepared last spring by V. R. Covell, county engineer, and were approved as to channel location and clearance height by the War Department. The design was then submitted by the county to the Pittsburgh Art Commission, whose approval is required for all city structures exceeding $25,000 in cost but which has no authority over county construction; this commission declared the county design to be "inadequate and unworthy." Later the county commissioners requested the local chapter of the American Institute of Architects to recommend a number of architectural firms for the artistic development of the three bridges.

Prior to this a joint conference committee of the chapter and the Engineers Society of Western Pennsylvania had considered the question of engineering and architectural work in bridge design, and under date of May 22 passed a resolution recommending that the county engineer be in direction of the design and construction of the bridges, that engineering and architectural consultants of experience be retained to advise him, and that the art element be recognized as an important

(Continued on p. 157)

Design of Bear Mt. Bridge Attacked as Ugly

Contributing Editor of the Outlook Characterizes Structure as Shown by Artist as "Tin Trumpery"

An attack on the design of the Bear Mountain suspension bridge across the Hudson River, now under construction, was published by Lawrence S. Abbott, contributing editor of *The Outlook*, in the July 18 issue of that magazine. The article says that because a beautiful bridge would draw sight-seeing tourists to New York and so "promote the money-making power" of the city, the Bear Mountain bridge design should be deplored; that the men who conceived the structure are apparently not men of architectural training; and that the bridge, judged by an artist's aerial perspective of the design (reproduced herewith), "looks in its wonderful setting of mountains and river like a piece of tin trumpery." It charges that many good judges are united in saying that the piers "look like poles carrying high-tension electrical power" and should be of stone. And, after admitting that the author is not competent to say what kind of bridge should be built at the site, it affirms that the design shown is "hopelessly incompetent." Finally, the article rumors that members of the Palisades Park Commission are interested in the bridge as stockholders, that they are thus acting as judges in a matter in which they have a pecuniary interest, and that "they are permitting an impression to get abroad that they are not insisting on a clean-cut distinction between questions of private profit and public trust."

The Palisades Park Commission, an interstate body of New York and New Jersey in charge of the management of Bear Mountain Park, a forest reservation along the west side of the Hudson, which the western end of the bridge touches, authorized the bridge company to build its approach, and in this connection approved the design after certain minor changes were made.

J. D. White, chairman of the Palisade Park Commission, in a statement replying to the article, says that upon receiving the original design the commissioners criticised the piers and engaged the best architectural advice obtainable, with the result that the design was changed. He also says that the legislative charter specified steel towers, and that the commission was bound by this requirement; and he cites the approval of the plans by the state engineer, the War Department, by William H. Burr, consulting engineer, and experts of the commission.

Speaking for the company which is building the bridge, E. Roland Harriman, president, says:

"The type of design was accepted after expert study of its soundness and adequacy and the consideration of other types. Eminent engineering and architectural advice was sought, and while it was realized that massive stone towers and corresponding architectural treatment would undoubtedly add to the attractiveness of the bridge, it was found that adequate structures of this nature were impossible because of the physical limitations of the site and would involve an additional cost that was prohibitive. The company was, therefore, confronted with the alternative of providing a well designed and adequate bridge which will be of the greatest benefit to the public and the state or the abandonment of the project, of which it chose the former. It is felt by those responsible for the affairs of the bridge company that they are willing to rest their case on the merits of the design when the project is complete."

The bridge has a span of 1,632 ft. between towers, and side spans of 210 ft. each. The cable sag is 200 ft. and the camber of the roadway in the main span about 15 ft. It was designed by Howard C. Baird.

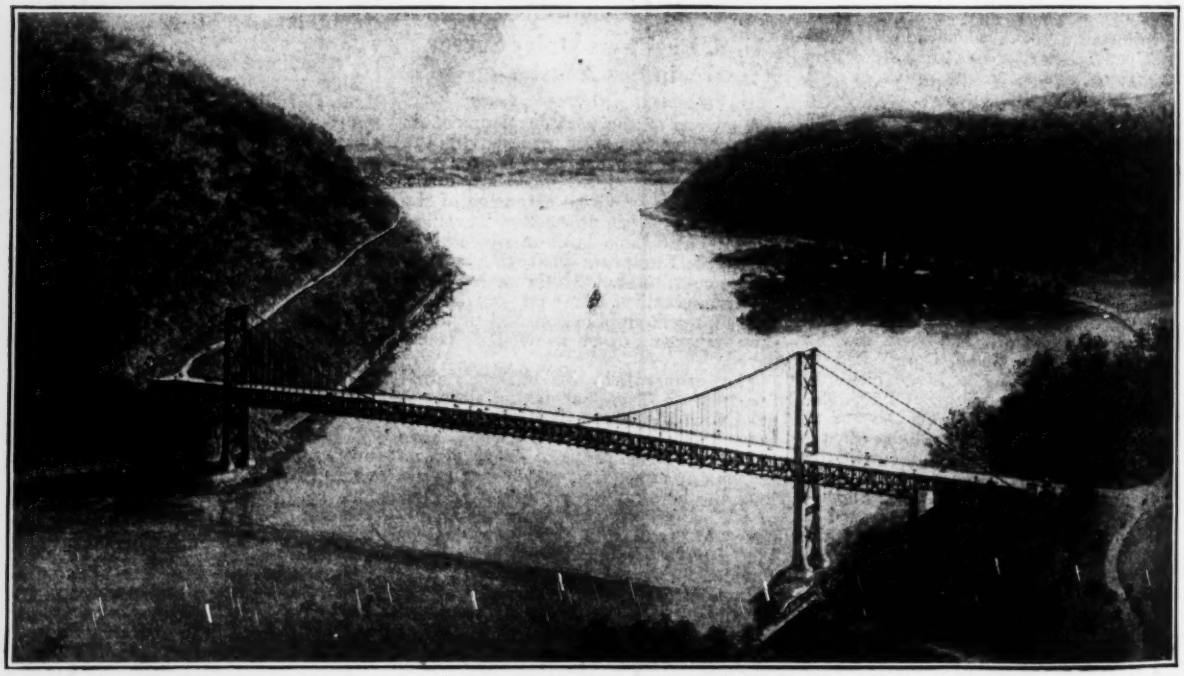
A.A.E. to Ask Congress Investigate Dismissal of A. P. Davis

A congressional investigation of the dismissal of Arthur P. Davis as director of the U. S. Reclamation Service will be asked for by officials of the American Association of Engineers, the matter to be followed up by the committee on political policies. The Civil Service Reform League has been urged by A.A.E. to look into the circumstances of the dismissal.

"Information from several sources all point to this course as the wise one," said Webster L. Benham, president. "We admit at the outset that in the selection of an executive, the person directly responsible for the work is entitled to exercise his judgment in appointing his subordinates. While this is the essence of executive control, we view with grave concern the dismissal without notice of an admittedly capable engineer who has been in administrative charge of an important government service for many years. We are particularly concerned in that such is purported to have been accompanied by threats intended to intimidate Mr. Davis into giving out publicly a statement that the resignation was initiated by himself."

New York-Duluth All-Water Service to Be Opened

A nine day all-water service between New York and Duluth without transshipment, starting in August, is announced by the Minnesota-Atlantic Transit Co. The route will be by way of the Hudson River and the Barge Canal to Oswego on Lake Ontario, thence by way of the Great Lakes and the Welland Canal to Duluth. The motor barges will be 285 ft. long by 42 ft. wide, and 19 ft. deep, with a carrying capacity of 2,000 tons. They will be propelled by Diesel engines and will operate under their own power.



ARCHITECT'S AERIAL PERSPECTIVE OF THE BEAR MOUNTAIN SUSPENSION BRIDGE

Bridge Design of Architects Again Under Discussion

(*Concluded from p. 155*)

factor. The resolution also advised against professional competition for designs. On July 10 the architects' chapter submitted the names of thirteen architects for the design and supervision of bridge construction and at the same time disavowed the committee resolution as not representing architectural opinion and as having been unauthorized.

On the architectural attitude the following statement of E. B. Lee, president of the chapter may be quoted, "No city in the world's history has ever had such an opportunity to design and erect in one group three great bridges under a comprehensive plan, which thus gives their creators so rich a chance to consider the whole picture as it shall be presented to the eye up the river, down the river, and from either shore." John W. Beatty, director emeritus of the department of fine arts, Carnegie Institute, who has taken a prominent part in the movement to place architects in charge of the bridge design, said in regard to the request of the county commissioners for names of architects, "This simply means that able men will finally be chosen to create the designs for these bridges and that they will be architecturally important and beautiful. This is as it should be. The day has gone by for the erection of bridges without regard to grace and beauty of line. Pittsburgh will therefore take a foremost place among American cities in this respect and I predict that it will in time become known as the City of Beautiful Bridges."

Engineers Protest

Resolutions of protest against the delegation of the bridge design to architects have been passed by the Engineers' Society of Western Pennsylvania and by the Board of Direction of the American Society of Civil Engineers. Protest was also made by the Pittsburgh chapter of the American Association of Engineers, pointing out that safe and proper construction is the primary essential in bridge design and that architectural appearance is only of secondary importance. The resolution of the Board of Direction of the American Society of Civil Engineers is as follows:

Whereas, it has been brought to the attention of the Board of Direction of the American Society of Civil Engineers that the Commissioners of the County of Allegheny, Pennsylvania, have under consideration the employment of architects for preparing plans and specifications and for supervising the construction of several important bridges in the city of Pittsburgh and

Whereas, these bridges are primarily engineering works demanding safety and economy and involving principles of design, construction and maintenance which come indisputably within the province of engineers and

Whereas, it is detrimental to the public interest to subordinate safety utility adequacy for future traffic and cost of these structures to their appearance, although it is recognized that the embellishment and aesthetic features of bridges may properly be entrusted to those especially skilled in architecture

Therefore be it resolved, that the responsibility for the design and supervision of construction of such bridges should be entrusted only to qualified civil engineers and that a copy of this resolution be transmitted to the Commissioners of the County of Allegheny through the Secretary of the Pittsburgh Section of the American Society of Civil Engineers.

Santa Fe to Spend $60,000,000

The need for additional railroad facilities is noted in the annual report of the Atchison, Topeka & Santa Fe Ry., which states that: "One outstanding feature of the year's railroad operations is the clear demonstration of the country's imperative need for greatly increased transportation facilities, a need which has been realized and persistently urged by the railroads since the termination of federal control." At the beginning of 1922 the company undertook as large a program of improvements as seemed possible and carried it through; but only a beginning was made of providing for the traffic demands of its territory.

For the year 1923 contracts were let for 7,150 freight cars and 59 new locomotives; this equipment with passenger cars on order and improvements to existing equipment, will cost upward of $24,000,000. The second-track work undertaken and authorized since the beginning of 1922 involves an expenditure of over $15,000,000. Preliminary work is under way for a new double-track bridge over the Mississippi River, on the Chicago-Kansas City line, to cost $4,000,000. Enlargement of shops, terminals and sidings will be pushed and it is probable that cash expenditures during the year for all improvements and equipment will amount to at least $60,000,000. "The improvements have been practically confined to what will increase handling traffic, other improvements, even though desirable, being deferred, because the present program is all that the company can efficiently handle this year."

Southern Pacific Co. Surveys New Line in Oregon

Surveys for a new railway line to connect California and Oregon are now being made by the Southern Pacific R.R. Co. The new line which is in the old Central Pacific territory will extend from Kirk, a point southeast of the Cascade Mountains, over the mountain to Oak Ridge, a distance of about 118 miles. Construction was started on this line a few years ago working from both ends but it was stopped by the central & Southern Pacific litigation and will not be taken up again until this litigation is settled.

N. Y. Aerial Survey Proposed

Aerial photographic maps of New York City, covering the area within the legal limits of the city and made on scales of 600 ft. and 2,000 ft. to the inch, are soon to be made by the Fairchild Aerial Camera Corp. It is expected that the photography will be completed by November 1 and that the maps made therefrom will be finished about April 1, 1924. The proposed aerial survey is strictly a city enterprise and title to all photographic negatives, as well as reproduction rights, will be vested in the city under the terms of the contract.

Hirst-Potts Charges Are Modified at Hearing

"Revenge" Only Motive Now Charged Against Potts—Stock Conferences Before Trenton Plans Filed

Modification by E. Jerome Hirst of the Direct-Oxidation Disposal Corp., of Philadelphia, of the charges made by him to Governor Silzer against Cylde Potts, an engineer-member of the New Jersey State Board of Health, in connection with the Trenton sewage-works plans, was the chief feature of the hearing at Trenton July 24. The hearing was held by Dr. J. C. Price, director of the New Jersey Department of Health, at Gov. Silzer's request.

In Mr. Hirst's charges dated Feb. 19, 1923, he alleged that failure of the Board to act on Trenton's application for a sewage-works permit filed Dec. 15, 1922, "was attributable unequivocally to one member of the State Department of Health, Clyde Potts, a consulting engineer of New York and Mayor of Morristown, N. J." In his charges Mr. Hirst said no other motive for Mr. Potts' opposition to the Trenton plans was apparent except that Mr. Potts "sought and was denied donation of a large stock interest in the patented process involved" in the Trenton plans. Mr. Potts sent a letter to Governor Silzer denying the charges, both against himself and as against the other members of the board as having been influenced by him. (See *Engineering News-Record*, March 8, 1923, p. 462; March 15, p. 507; Apr. 5, p. 635.)

At the hearing on July 24 Mr. Hirst voluntarily stated that Mr. Potts had not improperly sought an interest in the Direct-Oxidation Process, while on cross-examination by Mr. Potts' attorney Mr. Hirst made it plain that the stock incident occurred in 1918-1919.

Mr. Hirst brought out nothing at the hearing that was definite as to negotiations with Mr. Potts as to a stock interest in the Direct-Oxidation Process, beyond the statement that a citizen of New Jersey suggested to a man in Reading, Pa., that it would be advisable to engage Mr. Potts' interest in the process; and that Mr. Potts attended several conferences on the subject in 1918-1919, at which various witnesses named by Mr. Hirst were present, and at which Mr. Potts was favorable to the process and alleged that he could help get the process adopted in the Middle West. The Direct-Oxidation people, Mr. Hirst stated, decided against giving Mr. Potts an interest because they finally concluded that to have a consulting engineer thus interested would be bad policy.

Mr. Hirst also stated that his decision to file charges against Mr. Potts was reached on hearing indirectly that Mr. Potts was opposed to the approval of the Trenton plans, after having expressed himself favorably to the process during the negotiations. Mr. Hirst could see neither then nor at the time of the hearing any reason for Mr. Potts' approval except "revenge" and "instirctive opposition."

Mr. Hirst's general statements as to conferences with Mr. Potts about giving the latter an interest in the Direct-Oxidation Process were confirmed by F. D. Chandler, of the banking firm of Chandler Bros., Philadelphia.

Mr. Potts, who was present at the hearing, replied through his counsel that in view of the record it seemed useless for him to make a statement.

Random Lines

"How Firm a Foundation"

Sir—I have noted with interest recent attention paid the ever-widening scope of the engineering profession. I propose a candidate for the concrete moustache-cup. You will find him on the outside back cover of that estimable magazine *The Christian Century*, in an advertisement by that equally estimable publisher, The Century Co. He is the author of "Hymns for the Living Age." But let me quote the advertisement:

"When you plan a church edifice you consult an architect; when you want an organ you go to an organ builder. The hymn-book is just as important. Consult a man who is giving his life to the development of congregational singing. H. AUGUSTINE SMITH, **the** HYMN-BOOK ENGINEER, **has done more for church music than any man of his generation."**

K. H. B.

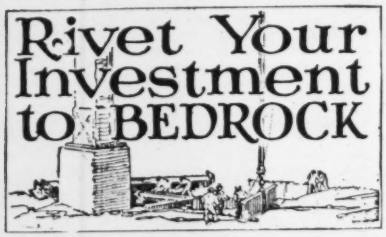
Sir—*Out our way there is a sign* "Horticultural Engineer" *in large letters across the window front of a place of business on the main street. A little further observation indicates that the chief activity of the proprietor lies in promoting the sale of certain lands, said to be suitable for apple production.*

J. J.

* * *

From the Bottom Up?

"RIVET YOUR INVESTMENT TO BEDROCK," says the New York Title & Mortgage Co. (Capital funds over $8,000,000) in an advertisement headed by this sketch. Here are possibilities of a new form of riveting technique. In



riveting bedrock we can visualize the man who operates the compressed air gun but we can't figure out how the "holder-on" functions.

* * *

They All Look Good When They're Far Away

In America a time-table is not a thing to miss trains by. When it says a train will leave such and such a place such and such a time it does; and, more important still, it sees that it gets there when the time-table says it should. Portion of a coupon ticket issued on one of the American railways was circulated on a Sydney suburban train one morning recently—the train was 55 minutes late—and every passenger read it twice before he'd believe his eyes. It says that if the train arrives at its destination 55 minutes late, the fare—full fare, that is—will be refunded. Of course, it wasn't a fair thing to circulate in a Sydney suburban business train, running almost an hour late.—From the Sydney, Australia, *Sun*.

Committee to Report California's Highway Needs

The Governor of California has has signed a bill passed by the recent session of the state's legislature authorizing the appointment of a committee of nine to enter upon a detailed and comprehensive study of the road problem of the state.

The committee, which is to serve without pay, is to "propose a complete system of state roads, study types of construction and materials to be used, recommend the inclusion of additional mileage, the exclusion of certain legislative roads now included in the system, and the time to be occupied in the completion of the system." This report is to be made to the legislature two years hence and is to include some plan for financing the necessary work. The engineering department of the commission estimates that to complete the 6,500 miles of highway now included in the system will require at least $200,000,000.

An announcement issued by the Highway Commission in commenting on this states: "To issue bonds for so vast a sum would seem to be bad financing, so some other mode of raising funds for new construction would seem advisable. It might come from a gasoline, weight or tire tax made just sufficiently large to carry construction over a period of years. There is also a widespread and growing sentiment in the state in favor of an oil production tax of a few cents a barrel or small percentage of selling cost."

The bill provides that the new committee shall be composed of the state highway engineer, one member of the state highway commission, one member of the state board of control, one member each from the state senate and assembly and four from the state at large to be named by the governor.

Steel Canopy Over Broad Street Station Being Removed

Work of removing the steel canopy that covered the fire-wrecked Broad Street station of the Pennsylvania R.R. is progressing rapidly. The wooden understructure has now been completed, and demolition of the steelwork started last week.

The scheme of demolition is by use of a wooden structure erected upon four-wheel car trucks. This wooden structure has a platform at the top from which the steel canopy can be reached. A central section of the wooden falsework reaches to the top of the structure. Two canopies on each side cover the tracks being used for trains, protecting them and at the same time providing space for handling members removed from the structure. The central traveler is capable of reaching any portion of the shed roof. Railroad engineers state that the demolition will require four to six weeks.

A feature of the recent fire in the trainshed is the effect of the fire upon the paint. In several places on the north wall of the shed, the outer coat of black paint has been blistered and has chipped off completely, but the priming coat of red lead paint is bright and in good condition. Most of the spots where such effect is noted are near the floor level where the heat was less intense, but a few spots are about half way up the structure.

Jobs Open for Reserve Officers

The Corps of Engineers will employ reserve officers as civilians, according to an announcement made by the Chief of Engineers on an important survey being made of the Tennessee River, under direction of the District Engineer in charge of river and harbor work at Chattanooga. The work will include the preparation of maps by aerial photography surveying and the collection and interpretation of stream-flow data. Experience in hydro-electric power and flood-prevention work will be an advantage. Salary will be from $200 to $325 per month and the period of employment will be one or two years. Positions are also announced by the District Engineer at Chattanooga for three junior engineers to assist in making computations, plans and estimates of navigation and power plant structures, and six junior engineers to take charge of survey parties.

18-Ft. Channel for Merrimac Is Subject of Controversy

Washington Correspondence

That the Board of Engineers for Rivers and Harbors does not regard an 18-ft. channel in the Merrimac River as an entirely practicable improvement could be judged from the attitude of members of the Board at the recent hearing in which the advisability of such a channel was urged by numerous witnesses. They argued that this channel would provide cheap transportation to the several populous mill towns along the Merrimac. The principal need for the channel, it was contended, is to bring in coal.

Representatives of the mills and other industries, however, testified that they are opposed to the project. It is their opinion that it would not justify the $12,000,000 or more which it would cost, at least half of which would have to be raised by the local interests. A depth of 18 ft., they pointed out, would be inadequate for the ships engaged in the coastwise coal trade.

Civil Service Examination

UNITED STATES

For the U. S. Civil Service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Valuation Engineer, and **Associate Valuation Engineer**—Vacancies in the Technical Staff of the Income Tax Unit of the Bureau of Internal Revenue, Treasury Department: valuation engineer in oil and gas, mining, timber, salary $3,600 to $4,800 a year; associate valuation engineer, salary $3,000 to $3,600. Applications must be filed with the Civil Service Commission, Washington, D. C., on or before August 31, 1923.

Junior Engineer, U. S. Geological Survey—Vacancy in the Water Resources branch of the Geological Survey, at entrance salary of $1,620 a year plus increase of $20 a month granted by Congress; work to consist of field investigations in any part of the United States, and the writing and review of resulting reports. Applications must be filed with the Civil Service Commission not later than Sept. 25, 1923.

Personal Notes

W. E. ANDERSON, engineer of Cameron County Water Improvement District 2, has resigned and accepted a position as manager of Cameron County Water Improvement District 3 at La Feria, Texas. During his three years' service with District 2, Mr. Anderson has also had charge of the street paving of San Benito, Texas, and has served as consulting engineer on the construction of the pumping plant and distribution system for Nueces County Water Improvement District 3 at Robstown, Texas, besides other consulting work in the valley.

G. F. SCHLESINGER, formerly chief deputy of construction in the Ohio department of highways, has been named state highway engineer of Ohio. Mr. Schlesinger was for several years assistant professor of civil engineering at Ohio State University and had served five years with the Rock Island Lines as assistant engineer on the St. Louis division.

DR. MATTHIAS NICOLL, JR., deputy commissioner of health of New York State, has been appointed commissioner to succeed the late Dr. Hermann M. Biggs. Dr. Nicoll was secretary of the department and director of public health education from 1914 to 1919 and has been deputy commissioner since the latter date. Before going to Albany he had been associated for many years with Dr. Biggs and with Dr. William H. Park in public health and laboratory work in the New York City Department of Health.

LEWIS D. ASMUS, of the U. S. Bureau of Public Roads, District 6, located in the Austin, Texas, sub-office, has been transferred to Baton Rouge, La., as assistant to M. J. Cramer, senior highway engineer, in charge of the State of Louisiana for the Bureau.

COLONEL FREDERICK MEARS, chairman and chief engineer of the Alaskan Railway Commission, has been appointed chief engineer of the Union Depot Co., St. Paul, Minn., to succeed WILLIAM C. ARMSTRONG, recently deceased.

WILLIAM E. WHITE, civil engineer, formerly in the Iowa State Highway Department's testing laboratories at Ames, has accepted a position with the George T. Wilhelm Co., construction engineers of Cedar Rapids, Iowa, for work on a 19-mile concrete road contract in Dyer County, Tenn.

A. S. HOLWAY, superintendent and chief engineer of the water-works of Oklahoma City, Okla., has resigned and his resignation has been accepted by the city commissioners. Mr. Holway will continue for a short time as supervisor of construction on the new filtration plant which is now nearing completion, after which he will join his brother in Tulsa in engineering work.

MARSHALL W. MARTIN, traffic commissioner of Arkansas, is now traffic manager for the George T. Wilhelm Co., construction engineers, Cedar Rapids, Iowa, and is located at Helena, Ark. He is in charge of materials on their contracts in southern territory.

JOHN L. LEHMAN, an engineer of Denver, has been made superintendent of the Trinidad, Colo., water-works. He succeeds Walter R. Lewis, who recently resigned after sixteen years' service in the department.

JEPTHA A. WADE, who has been engaged for the last two years on the design and construction of a pumping station, at Harrisburg, Pa., where he has been in charge representing James H. Fuertes, New York, has completed this work and is now with Viele, Blackwell & Buck, consulting engineers, New York.

RALPH H. GREENWOOD, who for the past three years has been conducting a private practice at Hamburg, Iowa, has taken a position as locating engineer with the state highway commission of South Dakota at Pierre.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 15-17.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga.; Nov. 12 to 16.

KALTENBACH BROS. have opened offices at 201 Board of Trade Building, Wheeling, W. Va., to engage in civil and architectural engineering work.

WEBSTER P. BUSHNELL, city engineer of Quincy, Ill., in 1912 and 1913 and civil engineer connected with various levee districts, specializing in reclamation of swamp and overflowed lands in Illinois and Missouri, has been again appointed city engineer of Quincy, Ill.

E. B. HILLMAN, formerly engineer and contractor, has been appointed a member of the board of local improvements at Quincy, Ill.

WILLIAM F. COCKE, state highway engineer of Florida, resigned July 10. No reasons have been announced for the resignation.

G. FRANK HYATT, formerly city engineer of East San Diego, Calif., and for the past three and a half years city manager of Coronado, Calif., has resigned to accept a position with the Bent Concrete Pipe Co. of Los Angeles.

HARRY J. KIRK, Defiance, Ohio, has been appointed chief engineer of maintenance in the Ohio Department of Highways and Public Works. Louis A. Boulay, director of the department, has also appointed the following division engineers: GEORGE E. CARR, Marietta, Ohio, District 10; MARTIN I. HENAHAN, Toledo, District 2; F. A. DAUM, Defiance, District 1; and FRED E. SWINEFORT, Akron, District 4.

FRANK W. SALFENGERE, civil engineer, has resigned his position as superintendent of construction at Fort Benning, Ga., to accept an engineering position with A. Bentley & Sons, contractors of Ohio. He will be stationed at Jacksonville, Fla., beginning August 1.

TOM J. ALLEN, who served during the World War as captain of engineers, has been elected city manager of Coronado, Calif., succeeding G. FRANK HYATT, resigned. Following the war Mr. Allen entered the service of the Erie R.R. as assistant division engineer at Youngstown, Ohio, and more recently has been connected with the engineering department of the Santa Fe R.R.

HADLEY BALDWIN has been promoted from assistant chief engineer to assistant to the general manager of the Cleveland, Cincinnati, Chicago & St. Louis R.R., with offices at Cincinnati, Ohio.

J. A. LENECEK has resigned from the engineering and construction department of the Erie R.R. at New York and accepted the position of chief engineer of the Quito-Esmeraldas R.R. in Ecuador. Mr. Lenecek will be in complete charge of locating, design and construction of this lengthy connection of the Ecuadorian capital with the sea coast.

EUGENE H. PAULUS has resigned as architect and construction superintendent of Federal Home Builders Corp. and is entering business under the firm name of E. H. Paulus Co., 4955 Northland Place, St. Louis, Mo.

M. H. MERRILL & Co. of Boston have opened an office in Dallas, Texas, at 608 Interurban Bldg. with Charles C. Allen as southwestern manager. This firm specializes in the design and construction of textile mills.

JOHN R. NICHOLS has opened an office at 161 Devonshire St., Boston, Mass., as consultant and designer in civil and structural engineering. Mr. Nichols graduated from Harvard in 1906, was for three years designer with contractors specializing in reinforced-concrete construction, four years instructor in mechanical and civil engineering at Harvard, and ten years with Monks & Johnson, architects, Boston, the last five years as their chief engineer.

LORENZO HAMILTON, architect and engineer of Meriden, Conn., has recently moved to new offices in the Dondero Building, that city.

SHEVLIN ENGINEERING CO., of New York City, power plant engineers, has recently established a branch office at 821 Chapel St., New Haven, Conn., with W. V. Pietsch as manager.

WYTHE M. PEYTON, Asheville, N. C., district engineer of the 9th district of the North Carolina state highway commission, has resigned and has opened an office in Asheville as a consulting engineer. JOHN C. WALKER, construction engineer of the highway commission, has been appointed to succeed Mr. Peyton.

J. C. NAGLE of the firm of Nagle, Witt & Rollins, consulting engineers, Dallas, and T. A. THOMPSON, chief engineer of the Wichita Falls Water Improvement District, have been selected as consulting engineers on the location of the proposed new Dallas reservoir for which $5,000,000 in bonds has been voted. Mr. Nagle is a member of the

firm who are district engineers for Dallas County on highway construction. He has been at various times dean of engineering at Texas A. & M. College, on the State Board of Water Engineers, and a major of engineers in the Officers Reserve Corps. Mr. Thompson is a hydraulic engineer of long practice in the southwest; he was both a designer and construction engineer of the Wichita Falls project.

Obituary

WILLIAM HOLABIRD, of Holabird & Roche, architects, Chicago, died July 19 at the age of 69 years. Following two years in West Point he spent several years in the office of W. L. B. Jenney before organizing the present firm of Holabird & Roche. He was one of the first to use steel-skeleton building construction, and is sometimes credited with originating the type. His first application of it was in the Tacoma building, at Madison and LaSalle Sts., Chicago. Subsequently his firm was the architect for the other three buildings on the same corner, LaSalle Hotel, Otis building, and Lumber Exchange. Mr. Holabird was one of the first to use sub-basement space, first in the Tribune building. His firm's latest structure in Chicago is the Chicago Temple building.

GEORGE WHITNEY BATES, city engineer, Lincoln, Neb., died July 11. Born 44 years ago in Hartford, Conn., Mr. Bates was educated at the University of Nebraska. From 1901 to 1907 he was a United States land surveyor in South Dakota and became deputy state engineer of Nebraska in 1905. Four years later he entered city service in the position retained until his death.

SIR JOHN STRATHEARN HENDRIE, president of the Hamilton Bridge Works Co., Hamilton, Ont., and former lieutenant-governor of Ontario, died July 17 at Johns Hopkins Hospital, Baltimore, aged 65 years.

THEODORE ISSON, of Chicago, structural engineer in charge of construction on a Fort Dodge, Des Moines & Southern Ry. bridge across the Des Moines River at Rivera, near Boone, Iowa, was electrocuted when the derrick on which he was working came in contact with a trolley wire. The heavy current had been ordered shut off, but before the disconnecting switch was turned the contact between derrick boom and trolley wire had been made. The accident happened July 12.

MAJOR HENRY H. WADSWORTH, consulting engineer of San Francisco, died in that city on July 11 after an illness of several months. Major Wadsworth graduated from Sheffield Scientific school, Yale, in 1886. For fourteen years he was engineer for the California Debris Commission; during the war he held the rank of Major, Engineer Corps, U.S.A.; and last year he was chairman of a committee selected by the Oakland Chamber of Commerce to investigate the water supply of the East Bay cities and make recommendations for necessary developments. At the time of his death he was vice-president of the San Francisco Section Am. Soc. C. E.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Canvass Opinion on Need of 21-S Concrete Mixers

Joint Committee on Construction Equipment Queries Contractors as Part of Standardization Program

Members of the Associated General Contractors of America are being asked for their opinion as to the advisability of manufacturing side-loading building mixers with a capacity of 21 cu.ft. Ballots are being sent out by the Joint Committee on Construction Equipment, which met in Chicago June 27-29, as reported in *Engineering News-Record* of July 5, p. 36, and July 19, p. 120. At that meeting there was a difference of opinion among concrete mixer manufacturers as to the need for the 21-S mixer. Certain companies believed that two sizes larger than the 7-S, namely the 14-S and the 28-S, were capable of serving the industry satisfactorily; others felt that the 21-S size should be included. It was agreed, therefore, to ascertain the desires of contractors.

In the Joint Committee's report it is stated that if the 21-S size is desired its capacity shall be a four-sack batch of 1:2:4 mix and a three-sack batch of 1:3:6 mix, based upon 40 per cent of voids in sand and stone and a maximum of 1½ gal. of water per cubic foot of mixed concrete.

ARGUMENTS, PRO AND CON

The size under discussion is that commonly designated as a ¾-yd. mixer. From the construction viewpoint the real issue is whether the job economics actually necessitate a mixer of this size.

The points mentioned in favor of the 21-S mixer were as follows:

(1) The weight and capacity of the 21-S fit in economically with many jobs where the larger machine would be cumbersome and over-sized.

(2) Some construction companies are already standardized on a ¾-yd. machine and would not like to change.

(3) The ¾-yd. machines can be more conveniently moved from one city job to another than the 1-yd. machines.

(4) The job economics create a need for both the ¾ and the 1-yd. mixer.

In opposition to the 21-S size it was pointed out: (1) Certain mixtures of concrete for full-sack batches will overrun the capacity of a ¾-yd. machine and necessitate using either the 28-S at a slightly reduced capacity or the ¾-yd. machine at the next lower even-sack batch.

(2) The drum of the 28-S building mixer is used on the 21-E paver and elimination of the ¾-yd. machine will permit greater production on a single size, reducing the number of parts and the production costs.

(3) Sales during the past year indicate that the 28-S is growing in favor.

(4) Concrete towers are being standardized on 1-yd. capacities.

(5) The 28-S can be operated economically at less than full capacity and covers a wider range of jobs than the 21-S.

To Reduce Wire Fence Styles

Elimination of 87½ per cent of the styles of woven-wire field and poultry fences was recommended at a conference July 12 between manufacturers representing 85 per cent of the fence manufacturing capacity of the United States and W. A. Durgin, chief of the Commerce Department's Division of Simplified Practice. The recommendations include that no rolls of poultry fence be manufactured except 10 and 20 rod rolls and that no rolls of field fence be manufactured except 10, 20, and 40 rod rolls.

A. G. Moore of the Fence Institute and chairman of the committee representing the fence manufactured, declared that "if the above styles are adopted by the entire fence industry, as recommended, the styles now made by 27 manufacturers will be reduced from 552 styles to 69. Considering all of the different sized packages as previously made there was a total of 2,072, while in the simplified program there are only 138 packages.

Standards for Wheelbarrows Approved by Committee

At a meeting of the Joint Committee on Construction Equipment held in Chicago, June 27-29, wheelbarrow manufacturers representing about 95 per cent of the construction wheelbarrows production of the country presented for approval a report on the standardization of wheelbarrows and a plan for establishing the standards. Their report was approved by the Joint Committee in accordance with the following:

With respect to trays wheelbarrows were grouped into four classes as follows:

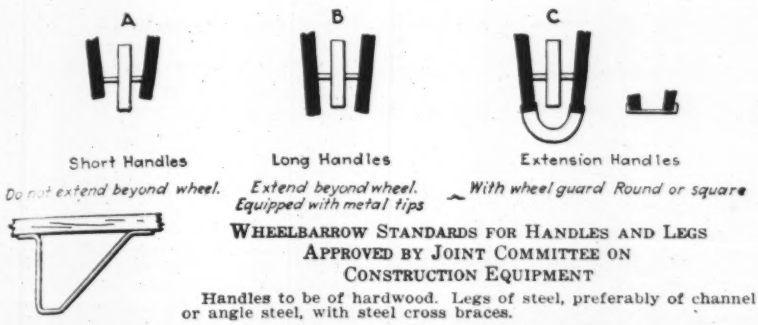
Class	Capacity Cu.ft.	Gage
1	2	18-15
2	2½	16or15
3	3	16
4	3½	16

Classes 1 and 2 have trays of medium capacity intended for dry material wheeling. The capacities are struck level capacity of dry material. For wet material figure one-third less capacity in wheeling position. For heaped dry material capacity add one-third to struck capacity.

Classes 3 and 4 have deep trays intended especially for wheeling wet materials. The capacities rated, however, are level full dry material. Figure one-quarter less of wheeling capacity for wet materials, and add one-third for heaping capacity of dry materials.

Three types of handle were adopted as shown in the accompanying sketch. All handles are to be of hardwood. Wheelbarrow leg construction for A. G. C. A. requirements is of steel, preferably of channel or angle steel, with steel cross-braces.

The final development of the standards is to be officially tied in with the American Engineering Standards Committee, and sponsorship for the development is to be placed with the Associated



WHEELBARROW STANDARDS FOR HANDLES AND LEGS APPROVED BY JOINT COMMITTEE ON CONSTRUCTION EQUIPMENT

Handles to be of hardwood. Legs of steel, preferably of channel or angle steel, with steel cross braces.

General Contractors of America and the American Society of Mechanical Engineers.

Standards are to be designated as A. G. C. standards until such time as the American Engineering Standards Committee authorizes them to be designated as American Standards.

The proposed standards are to become effective upon approval of the Executive Board of the Associated General Contractors and will as soon as possible thereafter be followed in the manufacture of wheelbarrows.

Large Use of Equipment Indicated by Federal-Aid Road Program

For manufacturers of road building equipment and materials the extent of the federal-aid road building program is indicated by the mileages, by states in the accompanying table. Roads which will comprise the federal-aid system of highways have been definitely designated in 34 states according to the U. S. Bureau of Public Roads.

A study of the system in the 34 states now approved shows that nearly every city of over 5,000 population is located upon it and the few which are not will connect with it over improved roads. The indications are that over 90 per cent of the entire population of the United States will live within 10 miles of a federal-aid highway. In a number of states the figure is as high as 98 per cent and in none of the states will it drop below 65 per cent.

In the tabulation of the mileage in the system by states estimates are given for those states whose systems are not yet approved.

MILEAGE OF FEDERAL-AID HIGHWAY SYSTEM

State	Federal-Aid System Miles	State	Federal-Aid System Miles
Alabama	3,958*	New Hampshire	988
Arizona	1,498	New Jersey	983
Arkansas	5,037*	New Mexico	3,258
Calif.	4,467	New York	4,498
Colorado	3,360	North Carolina	3,816
Conn.	835	North Dakota	4,855*
Delaware	266	Ohio	4,506
Florida	1,855	Oklahoma	7,889*
Georgia	5,662*	Oregon	2,814
Idaho	2,772	Penn.	3,954
Illinois	4,987*	Rhode Island	165
Indiana	3,957	South Carolina	3,179*
Iowa	7,154	South Dakota	8,077*
Kansas	6,423	Tennessee	4,565*
Kentucky	3,250	Texas	11,655*
Louisiana	2,667*	Utah	1,430
Maine	1,393	Vermont	1,043
Maryland	1,036	Virginia	3,016
Mass.	1,290*	Washington	2,887
Michigan	4,582	West Virginia	1,901
Minnesota	6,801	Wisconsin	5,516*
Miss.	3,290*	Wyoming	3,234
Missouri	7,040		
Montana	4,697		
Nebraska	5,500		
Nevada	1,456		
		Total	187,406

*Estimated.

Winter Discounts on Materials Sought by Contractors

Following the convention in Los Angeles last spring, the Associated General Contractors of America, through its committee of methods, is seeking from material manufacturers winter discounts on their products in order to equalize sales throughout the year, insure early deliveries and reduce shop costs. It is pointed out by the contractors that early delivery of materials on the construction site means an early start in construction work each year and thus tends to lengthen the construction season. This result, coupled with an increased use of construction machinery, it is hoped, will offset the shortage of labor.

A. P. Greensfelder, chairman of the Committee of Methods of the A.G.C., has prepared a memorandum headed "Winter Discounts—Fourteen Points" reproduced herewith.

Winter Discounts

Reduce construction costs.
Induce twelve months' sales.
No pyramiding of peak prices.
Lengthen construction season and insure early spring field work.
Reduce shop costs.
Discourage seasonable unemployment.
Intelligently reward early buyers.
Make savings to users and manufacturers.
Cause continuity of manufacture.
Reduce overhead costs.
Create uniformity in production.
Cut transportation delays.
Take account of steady labor.
Standardize factory practice.

It is suggested by the contractors that manufacturers offer a winter discount on contracts awarded in December, January and February, and only on such shipments on these contracts as are made within these months.

Brick Men to Meet in Los Angeles

The Common Brick Manufacturers' Association of America, Cleveland, will hold its next annual convention during the week of Feb. 11, 1924, in Los Angeles, according to a decision reached at a recent meeting of the board of directors.

The increased activity in the brick producing field on the Pacific Coast during recent years was a strong factor in deciding to hold the next convention in California.

Nine Cities Report Cast-Iron Pipe Mileage

From nine of the large cities of the United States the Cast Iron Pipe Publicity Bureau, Chicago, has secured figures indicating the mileage of cast-iron pipe used in their distribution systems. New York has the largest mileage and Philadelphia shows the earliest use of cast-iron pipe.

City	Total Miles Of Cast Iron Pipe	Date First Cast Iron Pipe Laid
New York	3,060.0	1832
Chicago	3,027.1	1852
Philadelphia	1,749.0	1801
Detroit	1,732.0	1838
Cleveland	1,063.0	1855
St. Louis	1,000.0	
Baltimore	1,102.6	1829
Boston	885.7	1847
Pittsburgh	749.3	1824

Construction Machinery Statistics Compared for 1914 and 1919

Based on the fourteenth census (1919) of the United States, the Department of Commerce has compiled statistics on the number and value of the country's industries. Those relating to machinery employed in the field of engineering and construction for the years 1914 and 1919 are presented below.

MACHINERY IN CONSTRUCTION FIELD

Class	Census Year	Number of Establishments	Value of Products
Air compressors	1919	44	$18,650,074
	1914	84	5,158,121
Blowers and fans	1919	69	12,141,246
Brick and clay machinery	1919	49	3,186,565
	1914	89	2,438,861
Concrete mixers	1919	62	10,450,344
	1914	44	2,956,058
Cranes			
Electric	1919	36	27,324,864
	1914		
Hydraulic and steam	1919	16	13,972,133
	1914		
All other	1919	59	11,237,025
	1914	26	4,194,457
Dredging machinery	1919	9	1,824,025
Elevators and elevator machinery			
Electric	1919	94	29,607,380
	1914		
All other	1919	157	40,579,919
	1914	213	17,228,101
Excavating machinery	1919	38	7,284,333
	1914	21	2,968,965
Meters, gas and water	1919	111	27,764,884
	1914	40	11,638,074
Mining machinery	1919	133	51,243,489
	1914	153	13,253,634
Pumps and pumping machinery	1919	228	66,456,444
	1914	298	27,456,916
Road making machines	1919	58	15,777,652
	1914	31	3,545,272
Steam shovels	1919	8	12,453,763
	1914	...	...
Well-drilling machinery, other than oil well	1919	30	2,566,668

Patent Office Rules on Trade Name

Trade marks involving an identical name may be used on products sufficiently unlike in character to avoid confusion in the user's mind. This, in effect, is the decision of the U. S. Patent Office in a case involving the use of the word "Eversharp" by the American Safety Razor Corp., Brooklyn, N. Y., as a trade mark for safety razors and blades, notwithstanding the prior use of the same trade mark by the Eversharp Pencil Co., Chicago. According to the Patent Office ruling the goods of the two companies are not sufficiently alike to cause confusion in trade by reason of the simultaneous

use of the mark on their goods. It was held, also, that the likelihood of the Eversharp Pencil Co. expanding its business to include razors was not such as to warrant a claim of interference with its business expansion and also that the mark was not merely the essential feature of the corporate name of that company.

Business Notes

GUY H. HALL, formerly director of the National Institute of Progressive Farming has been appointed manager of the division of public relations and sales promotion, newly created by the Holt Manufacturing Co., Peoria, Ill., and Stockton, Calif., manufacturer of Caterpillar tractors.

FOAMITE-CHILDS CORP., Utica, N. Y., manufacturer of fire-protection equipment and motor street sweepers, has leased a 2½-acre plot near its present plant for the construction of an outdoor experiment station.

M. P. MATTHIAS, export manager of the Foamite-Childs Corp., Utica, N. Y., manufacturer of fire-protection equipment, has sailed for South America on a tour which will include visits to the company's agencies in the Latin American republics.

FRED H. MARSH, formerly with the Pittsburgh-Des Moines Steel Co., Des Moines, Ia., is now with the Paxton & Vierling Iron Works, Omaha, Neb.

J. C. BLOOMFIELD, for a number of years with R. W. Hunt & Co., contractors, of Chicago, has assumed charge of the Chicago office of the Industrial Works, Bay City, Mich., manufacturers of cranes.

STROUD & CO., Omaha, Neb., manufacturers of dump wagons and earth-moving equipment, announce an involuntary petition in bankruptcy filed against them July 11. The court will be asked to appoint a trustee so that the business may be continued. The company states that it is in a position to make prompt shipment of elevating graders, dump wagons, scrapers, road maintainers, plows and drags, and that its present condition is due principally to the cessation of new railroad construction, closing a large outlet for earth-moving machinery. Another contributing factor is said to be the present gradual decline in earth-moving prices in the Missouri Valley, amounting to 20c. per cubic yard this year, as against 25c. in 1922, 40c. in 1921, and 60c. in 1920.

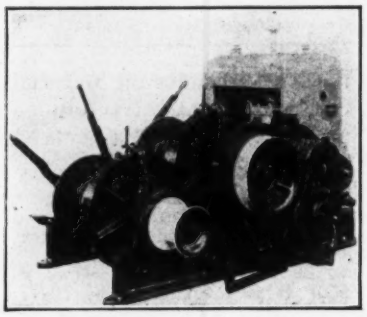
CONVEYORS CORP. OF AMERICA, Chicago, announces the appointment of the Pittsburgh Machine Products Co., Pittsburgh, as district representative. The Pittsburgh organization will handle the sale of American steam jet ash conveyors, airtight doors and cast-iron storage tanks, in western Pennsylvania and the northwestern part of West Virginia.

FORT PITT BRIDGE WORKS, Pittsburgh, announces the appointment of H. B. Speasmaker as assistant to President H. H. Blickle. For twelve years Mr. Spearsmaker served as purchasing agent of the Diamond Alkali Co., Pittsburgh.

Equipment and Materials

Gasoline Hoist with Reversing Elevator Sheave

Portability and independence of outside sources of power are among the advantages claimed by the Clyde Iron Works Sales Co., Duluth, Minn., for its new line of gasoline builders' hoists



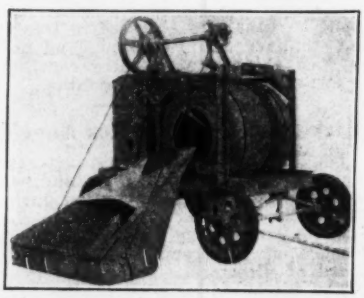
with reversing elevator sheaves. The hoist shown in the accompanying illustration is built with either one or two drums and an independent clutch elevator sheave which permits double cage operation, and in addition, leaves the friction drum free for hoisting forms, reinforcing, etc.

One exclusive advantage claimed for this hoist is that while the driving gear of the friction drum is non-reversible, the elevator sheave, by means of two separate clutches, may be reversed at will, independently. Patents covering this feature have been applied for. Motive power is supplied by a four-cylinder gasoline engine and transmitted to the drum through a silent belt chain drive.

Two New Models of Portable Building Mixer

Two new models of Rex mixers have been announced by the Chain Belt Co., Milwaukee, a ½-bag mixer known as the 234-S, and a 1-bag machine, the 237-S. Both are low-charging types and can be equipped with either a hinged platform or charging skip. In its new models the company's aim is to bring to the portable building mixer field the speed and low mixing cost of the larger paver.

In the drum of the new models the mixing blades and buckets have been



arranged to decrease the time required for discharging the batch, no matter what mixing proportions are used. The opposite side discharge control is of a new design to make the operation of the chute easier. The power charging skip has been constructed so as to reduce the time of charging the drum.

By mounting the countershaft up out of the dirt line and using a vertical engine, the new mixers have been made compact and sturdy. A short wheelbase makes them more readily portable, especially in close quarters. The front axle of the truck is built up of cold-rolled shafting and trussed channels to give it great rigidity. An adjustable malleable jack placed on the charging end of the axle gives the mixer four point suspension while mixing concrete.

The superstructure is of heavy steel angles gussetted in both directions. The main countershaft is mounted on self-aligning bearings high up on the machine, where it is accessible. An asbestos disc type of clutch which has a greater gripping area and is smoother in operation has superseded the old wood-block type of clutch. Self-oiling bushings are provided in the drum rollers which are of malleable iron construction.

The Rex 237-S is equipped with an 8 h.p., two-cylinder vertical, hopper-cooled Le Roi engine having a high-tension magneto, an automobile type carburetor and a throttling governor. On the Rex 234-S a 4 h.p. vertical gasoline engine is used. Rubber-tired disc wheels or built-up wheels are optional equipment. The disc wheels are equipped with phosphur bronze bushings to allow faster traveling over city streets.

Air Spring Seat for Drivers of Trucks or Tractors

To protect the health and insure the comfort of drivers of tractors or trucks an air spring seat has been designed which, according to its manufacturer, the Seibel Air Spring Co., Inc., San Francisco, eliminates vibration and jolting even over rough ground. The seat, which may readily be attached to a tractor or truck, involves an adaptation of the principle of the pneumatic tire. The cushioning effect is secured by means of a cone of heavy fabricated rubber in which is placed an inner tube inflated with air to suit the weight of the driver. The cone and inner tube are placed in a steel air box upon which is set a bucket seat. The whole presses upon a metal knob known as a deflector. The use of the new seat, it is claimed, increases the driver's efficiency.

Publications from the Construction Industry

Steel Joist Construction—TRUSCON STEEL CO., Youngstown, Ohio, has just published a 32-page illustrated data book on the application of and specification for its steel joists. The joists are shown in relation to Hy-Rib lath for floor and ceilings for both wooden floor and cement floor finish. The book contains a considerable amount of tabular

matter on safe uniform loads with various joist spacings, coefficients for deflection, weights of building materials, etc. About a dozen pages are given over to drawings of floor and partition details, balconies, grandstands, roofs, stairways, and framing around openings and in connection with the installation of pipe. Accessories, such as joist clips, screed clips, and hook staples, are shown in application.

Road Graders—RUSSELL GRADER MANUFACTURING CO., Minneapolis, has just published a 64-p. illustrated catalog of its line of road-building equipment, including graders ranging in size from the 5 to the 12-ft. blade type, dump wagons, elevating graders, road drags, scarifiers, wheel scrapers, plows, screens, and crushers. For each type of equipment specifications are given and the various parts, such as blades, wheels, back-slope attachments, etc., are described and illustrated in detail.

Motor Trucks—INTERNATIONAL MOTOR CO., New York, in a 44-p. illustrated pamphlet, presents information on the chain-driven type of Mack truck. These trucks are made with capacities of 1½, 2 and 2½ tons.

Culvert Pipe and Drain Tile—W. S. DICKEY CLAY MANUFACTURING CO., Kansas City, Mo., features its culvert pipe and drain tile for highway and road purposes in a 55-p. illustrated booklet, recently published. The information given includes results of a number of tests of vitrified pipe and special emphasis is given to the company's triple-strength pipe, which, in the 24-in. size, has a wall thickness of 2½ in. and a crushing strength of 6,000 lb. per linear foot. The text gives a number of useful suggestions on culvert construction with particular reference to head walls. A number of pages also are devoted to the Dickey vitrified salt-glazed segment block for sewers, ranging in diameter from 30 to 66 in.

Belting—CHARLES A. SCHIEREN CO., New York, has published under the title "Practical Facts About Belting" a manual on power transmission by means of leather belts. The text includes a discussion of different types of drive, belting rules and ratings, horsepower, care and operation of belts, joining engine belts, alignment, selection of proper kind of belt for the drive, plant layout and shafting.

Cement Roof Tile—AMERICAN CEMENT TILE MANUFACTURING CO., Pittsburgh, in a 64-p. illustrated catalog, explains in detail the design and uses of its Bonanza "Cementile" for roofing of industrial buildings, theatres, auditoriums, railway stations, etc. The product, which is a cement slab reinforced with galvanized wire mesh, is made in three types, interlocking, flat and channel. The tiles are laid directly upon the open roof purlins which are suitably spaced for the purposes. The dimensions of the standard interlocking tile are 26 x 52 x 1 in.; of the standard flat tile, 24 x 60 x 1¼ in.; and of the channel tile 18 x 96 in. with 1 in. width of web and 1⅝ x 3½-in. flanges. In addition to a varied selection of photographs illustrating the uses of the tile for roofing, about half of the catalog is given over to data sheets containing drawings of design details for roofs of different types.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Hoover Committee on Seasonal Building Organizes

An immediate survey to determine the facts of seasonal building was laid down as its first task by the Committee on Seasonal Operation of Construction Industries at its first meeting July 11 and 12 at Atlantic City, N. J. It is hoped to have this survey completed and a report prepared this year. As tentatively planned the survey will determine seasonal construction by regions and kinds of structural work, showing the dates of beginning and end of the normal building season for types of work, such as road building, dwellings, apartment and business houses, with the periods of activity and idleness for the different building trades. The survey will also cover seasonal production in building materials, to determine how far this is due to seasonal building operations and trade customs and how far to climatic conditions.

Paving Brick Shipments for June Show Increase

An increase of over a million brick in vitrified paving brick shipments for June as compared with May and a decrease in production are revealed by the monthly report just issued by the National Paving Brick Manufacturers Association from statistics of companies representing 67 per cent of the tonnage of the industry. Shipments in June were 27,251,000 brick as against 26,209,000 for May. June production was 31,105,000 as against 34,382,000 for May. The large number of lettings during the last month and the awarding of many contracts reacted in an increase in unfilled orders of 13,000,000 brick for shipment during the late fall and winter months.

The stock on hand reported shows over 80,000,000 brick.

Of the total shipments in June, 18,630,000 brick went into city streets and 5,631,000 into country highways. The remainder were shipped for miscellaneous uses, such as private drives, factory floors, and general construction.

Ohio led in consumption, closely followed by Pennsylvania, Illinois, Indiana, Minnesota and Texas in the order named.

Construction Materials Contribute to Freight Tonnage

Cement contributed 3,314,168 tons to the freight tonnage of the Class 1 railroads during the first quarter of the current year, figures just made public by the Interstate Commerce Commission show. This tonnage originated as follows: Eastern District, 1,573,435 tons; Pocohontas region, 52,257 tons; Southern region, 361,025 tons; Western District, 1,327,451 tons.

Brick and artificial stone during the first quarter contributed 3,887,171 tons to the amount of freight carried. Lime and plaster contributed 1,214,526 tons. Sewer pipe and drain tile, 424,508 tons.

Structural-Steel Sales

The Department of Commerce announces June sales of fabricated structural steel, based on figures received by the Bureau of the Census in co-operation with the Structural Steel Society. Total sales of 112,735 tons were reported for June by firms, with a capacity of 223,595 tons per month.

Tonnage booked each month by 175 identical firms, with a capacity of 229,575 tons per month, is shown below, together with the per cent of shop capacity represented by these bookings. For comparative purposes the figures are also prorated to obtain an estimated total for the United States on a capacity of 250,000 tons per month.

1922	Actual Tonnage Booked	Per Cent of Capacity	Estimated Total Bookings
April	200,588	87	217,500
May	184,638	81	202,500
June	168,498	73	182,500
July	157,631	69	172,500
August	156,011	68	170,000
September	146,146	64	160,000
October	132,450	58	145,000
November	111,794	49	122,500
December	138,024	60	150,000
1923			
January	172,415	75	187,500
February	183,938	80	200,000
March	218,997	95	237,500
April	185,335*	81	202,500
May	130,828**	57	142,500
June	112,785***	51	127,500

*Reported by 173 firms with a capacity of 229,225 tons.
** Reported by 169 firms with a capacity of 228,850 tons.
*** Reported by 152 firms with a capacity of 223,595 tons.

Canada's Building Permits Decline

According to reports tabulated by the Dominion Bureau of Statistics, there was a decline of 23.6 per cent in the value of building permits issued in Canada in June as compared with May. This decrease, according to the report, is often experienced during June, the largest aggregate of permits granted usually occurring in April or May, when the building season is commencing.

The comparison with June, 1922, also shows less projected activity during the month under review, there being a reduction of 15.9 per cent. Returns received from 56 cities showed that they had authorized building to the value of $14,345,573, whereas in May, 1923, the total had been $18,766,065, and in June 1922, $17,052,582.

Lumber Standardization Progresses

By its action taken at a meeting in Chicago, June 22-23, the Central Committee on Lumber Standards has largely paved the way for a general standardization conference to be composed of accredited representatives from all affiliated organizations interested in the standardization of lumber, to be held at the Department of Commerce in Washington next fall, to take final action on its recommendations, which will be binding on the entire lumber industry.

At the recent meeting in Chicago,

the Consulting Committee on Lumber Standards submitted a number of its recommendations to the Central Committee which were approved with very few changes. Briefly, the recommendations as approved cover standardization of lumber sizes, simplification of grade names, and the guaranteeing of quality and quantity through grade-marking and inspection service. Some of the recommendations are that standard finished yard boards should be not less than $\frac{25}{32}$ in. thick, and that standard finished dimension should be not less than $1\frac{3}{8}$ in. thick.

Bids Wanted on Big Jobs

Among projects on which bids are either asked or will soon be called for, in Construction News, pp. 43 to 60, are the following:

Railway, 6-mi., Alabama, from Fairfield to Wenonah, for Tennessee Coal, Iron and RR. Co., $4,000,000.

Dam, Merced, Calif., for Merced Irrigation Dist., $3,000,000 to $4,000,000.

Home and infirmary, Wende, N. Y., for Board of Supervisors, Erie Co., $1,500,000.

Coke ovens, Fairport, O., for Koppers Co., $1,500,000.

Foundation, for two story and basement temple, New Castle, Pa., for Scottish Rite bodies, F. and A. M., total cost, $1,000,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 43 to 60, are the following:

Temple, St. Louis, Mo., to Westlake Construction Co., $3,000,000.

Grain elevator, Vancouver, B. C., to Northern Construction Co., $1,600,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of July 5; the next, on Aug. 2.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb.	$3.64	$4.30	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.25
Structural rivets, 100 lb.	4.40	5.00	4.90	3.75	4.25	5.40	5.00	4.75	6.00
Reinforcing bars, $\frac{3}{4}$ in. up, 100 lb.	3.54	4.25	3.80	3.20	3.45	3.85	3.50	4.10	4.00
Steel pipe, black, $2\frac{1}{2}$ to 6 in. lap, discount	44%	52%	45%	47%	53-5%	36%	35.2@47.6%	40%	42.84
Cast-iron pipe, 6 in. and over, ton	62.30	—56.00	63.00	60.20	60.50	69.00	62.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	2.85	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, $\frac{3}{4}$ in., cu.yd.	2.25	1.90	2.25	2.00	—1.80	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.95	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, $\frac{3}{4}$ in., cu.yd.	1.75	2.00	2.50	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	63.00	—40.00	—52.25	58.50	42.50@44.75	47.00	41.00	—29.00	70.00
Lime, finishing, hydrated, ton	18.20	23.50	22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.35	1.50	1.50	2.70	2.10	2.80	10.00
Common brick, delivered, 1,000	+24.60@25.70	—13.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.109	.115	.0724	.0816	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1573	.109	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	—1.08	—1.10	—1.24	1.28	—1.16	—1.30	1.23	.86	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.55	.35@.50	.50	.50@.62½	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.45). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $42.84; 6-in., $108.

Changes Since Last Week

A slight stiffening in the price of common brick at New York, formed the single exception to the general downward trend of materials prices, during the week. Lumber and linseed oil are the two commodities most affected.

Yellow pine timbers dropped 50c. in Dallas and $2 per M. ft. in Atlanta, while Douglas fir declined $2 in Seattle. The lumber movement of the country for the week ended July 14, as reflected by reports from 403 of the larger commercial sawmills, to the National Lumber Manufacturers' Association, gained materially over the preceding week and the corresponding week in 1922, despite the recent recessions in price. Lumber production for the first twenty-eight weeks of the current year, totaled 6,765,076,783 ft., a gain of 1,116,738,035 ft. over the corresponding period last year. Shipments increased 20 per cent and orders over 13 per cent.

Improvement in pig-iron inquiries developed during the week. Lower iron prices for fourth quarter deliveries, have been checked by the growing firmness of the coke market. Steel bars remain firm at $2.40 per 100 lb., Pittsburgh, despite lower pig-iron and scrap spot prices. Slightly better inquiries for structural shapes developed during the last two weeks; quotations remaining firm at the $2.50 base, with few prospects of lowering. New plate orders fell off slightly during the week. Steel mill operations are slowing down gradually, owing to seasonal influences.

Linseed oil declined 2c. in New York and Minneapolis, 4c. in Denver, 6c. in Dallas and 10c. per gal. in Atlanta, since July 19.